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An Analysis of the Projected Manpower Requirements for the Shuttle Processing Contract

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AN ANALYSIS OF THE PROJECTED MANPOWER REQUIREMENTS FOR THE SHUTTLE PROCESSING CONTRACT

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SECTION 1
EXECUTIVE SUMMARY

As a consequence of the significant increase in the planned levels of manpower on the Shuttle Processing Contract (SPC) at the Kennedy Space Center (KSC) projected in Program Operating Plan (POP) 87-1, the Director of the National Space Transportation System (NSTS) directed that a detailed review of the SPC manpower be undertaken. A review team was formed, headed by Jim Adamson and composed of representatives from NASA Headquarters (Norm Starkey/MOK, Richard Schneider/BR, Mal Peterson/B) and Level II (Jim Adamson, Tom Foster). Detailed briefings were given to the review group by KSC personnel, with participation by the Lockheed Space Operations Company (LSOC), during the June 8-16 period. Further meetings with KSC personnel were held in mid-July. This report provides the background, analyses, and findings of the team.

In the six month period (August 1985 through January 1986) prior to the loss of the Challenger and its crew on Space Transportation System (STS) 51-L, the average headcount of LSOC and its team members (Grumman Aerospace Corporation, Morton Thiokol, and Pan American World Airways) was 6,117. At that time, the average launch rate was about one per month. Considerable overtime was required of the contractor workforce to achieve the launch rate, resolve hardware and launch system anomalies, and accomplish the directed modifications to the STS hardware. For example, after segregating the indirect personnel (413), those on leave without pay (LWOP) (56), and other fund sources (DOD, Centaur modifications and other Shuttle production and operational capability activities), the remaining direct headcount required for Shuttle operations in that period was 5,264. Factoring in overtime, the direct equivalent manpower was 6,022. Overtime percentages worked in vehicle processing and areas that directly support vehicle processing averaged over 20 percent.

After STS 51-L, a number of intensive reviews were conducted of the manner in which the Shuttle processing operations were conducted at KSC. The Presidential Commission on the Space Shuttle Challenger Accident criticized the level of overtime required by the SPC workforce in the period leading up to STS 51-L. The NASA prelaunch activities team report (included as an appendix in the Roger's Commission report) indicated that, "Problems found with paper, workmanship, lack of thorough understanding of requirements and configuration may well have their roots in the overloading of the available workforce. External factors such as late requirements also affect the efficient utilization of the available workforce, as well as inducing schedule perturbations that tend to exacerbate the problem of improper documentation discipline."

The corollary KSC report of the "Paperwork and Preparedness Review Teams," published February 20, 1987, resulted in three major findings: (1) paperwork systems should be enhanced to provide improved understanding and control; (2) KSC personnel should be thoroughly trained in procedures for origination, handling, and closure of paperwork; and (3) paper handling documentation instructions required updating and clarification.

The third significant analysis was performed on the SPC by a team led by Mr. Roy Estess. This review recommended that the SPC be retained, but also recommended (1) a substantial increase in interaction with design agencies, (2) stronger involvement in processing by engineering and quality assurance, (3) increased and improved training to assure discipline and performance, (4) adoption of a hybrid stationizing approach, (5) improved paper systems, and (6) focused attention of test preparation sheet (TPS) paper and (QA) oversight.

The findings and recommendations of these review teams played a significant role in the recommendation for SPC manpower levels, as reflected in the current KSC assessment. In total, KSC presented the team with a comparison which projected an SPC headcount level of 7,512 in FY 1990 against the 6,117 in the period prior to STS 51-L. This represents a 23 percent increase. If the overtime differences are factored in, the real growth in equivalent manpower is only 10 percent. However, for just Shuttle operations, the difference between 6,907 Equivalent Persons (EP's) and the figure of 6,022 EP's before STS 51-L represents an increase of 15 percent. Note that the key assumption is that the increase in headcount enables the overtime to be reduced to the 1 percent level by FY 1990.

For the same two periods, the changes, by organization or an equivalent, in total and for Shuttle Operations are shown in Table 1-1.

TABLE 1-1.- Changes in manpower levels from pre-STS 51-L to FY 1990.

Organization	Total, percent	Operations, percent
Sustaining Engineering	+ 134	+ 277
Process Engineering	+ 45	+ 55
Payload Integration	+ 21	+ 22
Support Operations	+ 10	+ 22
SR&QA	+ 19	+ 20
Shuttle Data Systems	+ 7	+ 10
Operations Control	+ 19	+ 20
Logistics	- 13	- 15
Shuttle Operations	- 6	- 6
Grumman launch processing system (LPS) Operation and Maintenance (O&M)	+ 3	+ 3
Morton Thiokol	+ 8	+ 8
Business Management	- 1	- 16

(Note that in Sustaining Engineering, and to lesser extents, in Logistics and in Support Operations, the comparisons are misleading to the extent that the SPC has recently assumed responsibilities which KSC previously

contracted for with other contractors-principally Planning Research Corporation (PRC). The Sustaining Engineering comparison would show an increase of 36 percent vs. the 134 percent indicated above if the PRC vs. SPC adjustment were used to normalize the data.)

The key reasons for these changes stem from the premise that the pre-STS 51-L manpower for engineering/quality control (QC) planning and control supporting the "hands-on" processing operations, the closed loop Operations and Maintenance Requirements Specification (OMRSD) for ground support equipment (GSE), and the facility GSE Operation and Maintenance (O&M) have to be augmented to meet the STS program emphasis following STS 51-L on the elimination of risk and on increased design center involvement in operations.

Our review, however, indicates that the revised estimates are only best estimates with significant inherent assumptions which are open to change. A key concern has to do with overtime assumptions. KSC plans to augment the workforce manning levels to achieve a 1 percent overtime goal in FY 1989, down from 5 percent in FY 1988. However, a 1 percent overtime rate is not regarded as achievable by both LSOC and KSC personnel, who believe 5 percent is more realistic. What is not clear is what KSC considers the appropriate manpower level, the 7,512 headcount plus 1 percent overtime, a higher level based on taking into account a greater overtime rate (such as 5 percent), or the 7,386 headcount with 1 percent overtime brought forward in POP 87-2. The dollar impact between the first two manpower levels amounts to about $16 million.

In addition, caveats are attached and assumptions are made which will affect these manning levels. Two caveats which could increase the estimate are: (1) no allowance is made for alterations in solid rocket motor (SRM) processing requirements which add work to the current timelines; and (2) implementation of the System Integrity and Assurance Program's (SIAP's) requirements for greater design center involvement and additional reporting requirements has not been factored in. With regard to the second caveat, KSC personnel noted that the need to obtain design centers' approvals could have a negative effect on processing timelines. Unless schedule is made the variable, overtime and additional staffing will be required to adhere to launch dates.

Four key assumptions which could be considered conservative are: (1) there will be a continuing high level of modifications to the Orbiters; (2) increased manning levels attributable to an explicit allowance for training do not translate into improved workforce expertise and resultant efficiencies; (3) in design engineering, there will be a constant level of modifications to KSC facilities and equipment even after return to flight (RTF) modifications are completed; and (4) the high level of emphasis placed on paperwork improvements (clarification of procedures) during the downtime does not improve workforce efficiency.

The review team has concluded that the central issue is the level of changes to flight and ground systems which will be required in the future. The comparison to the period immediately preceding STS 51-L to FY 1990 usually

cites the roughly comparable flight rates of one per month. Our review has identified activity levels, not flight rate, as the key variable. After making allowances for the increase in specific areas such as the presence of engineers on the floor or a 3.5:1 ratio of Orbiter Processing Facility (OPF) technicians to inspectors, the need to make further manpower increases or the possibility of reductions centers around the number of changes, their magnitudes, and the timelines of the implementing paper and hardware. In the face of no guidance to the contrary, KSC has assumed that the level of changes will be close to the period preceding STS 51-L.

SECTION 2
PURPOSE

The purpose of this review is to provide NASA management with an assessment of the need for the substantial increase in manpower level required for Shuttle processing at the Kennedy Space Center after the Space Shuttle has returned to flight operations. The review focused on obtaining a detailed understanding of the relationship between work requirements and associated manpower levels, comparing the situation in the six months prior to STS 51-L (January 1986) to that now projected for FY 1990. Finally, this report was generated to preserve the information gathered during detailed fact finding. It is hoped that this document will serve as a future reference for Shuttle processing manpower requirements.

SECTION 3
SCOPE

The scope of this review has been limited to a comparison of the actual manpower requirements for the six month period immediately preceding STS 51-L to the projected requirements for the first quarter of FY 1990. The review was conducted at a detailed level consistent with the organizational structure of the SPC. Functions, tasks, cost drivers, new work content, and work volume indicators were identified. The findings and recommendations generated by external and internal reviews (The Rogers Commission, The Congressional staff, The Aerospace Safety Advisory Panel, The Estess Team, and KSC's internal review) were also analyzed.

As noted previously, the first quarter of FY 1990 was presented as a basis for comparison by KSC. The team did examine data for the period of time from the present to October 1989 to identify the impacts of changing shifting and overtime assumptions.

The manpower data presented by KSC reflects current program requirements and stated assumptions. It does not reflect unapproved programs or potential threats which may subsequently impact SPC requirements. The KSC position reflects its own detailed review of the contract proposal submitted by LSOC for the current option period.

We noted that there is incomplete understanding on KSC's part of the potential impact of the Systems Integrity and Assurance Program (SIAP). The relationship of the augmented design center involvement (including the Launch Site Support contracts) to SPC manpower was examined, but KSC personnel were unclear as to its impact, except to point out that the degree of the design centers' involvement in the approval of test procedures, data analysis, etc. could pose a threat to the timely accomplishment of processing schedules.

SECTION 4
METHODOLOGY

4.1 TEAM COMPOSITION

The SPC manpower review team was composed of

- Jim Adamson, Astronaut, assigned to Level II Engineering Integration Office
- Mal Peterson, Assistant Comptroller for Program Status Review and Cost Assessment, NASA Headquarters
- Norm Starkey, Acting Chief for KSC Operations, Operations Utilization Division, Office of Space Flight
- Richard Schneider, Program Analyst, Resources Analysis Division, Office of the NASA Comptroller
- Tom Foster, Program Analyst, Level II Program Control Office

The team was assisted by a number of KSC personnel, including Jack Harden, John McBrearty and Doug Moody. In particular, we appreciate the secretarial support provided by Shirley Beck.

4.2 ACTIVITIES

KSC personnel made presentations on each SPC organization on June 9-10. From June 11-16, the team members conducted interviews with KSC and LSOC personnel. From July 6-10, several team members attended the POP 87-2 review to obtain additional information. The team convened again from July 14-16 to write its final report.

4.3 APPROACH

The team was briefed by KSC personnel on the comparative SPC headcounts for the two periods previously mentioned. Since a key factor in the projected headcount increase for FY 1990 was a reduction in the level of overtime experienced in the base period, the team collected data on the actual overtime. In addition, LSOC's organization had undergone relatively minor changes. At the team's request, LSOC provided the appropriate adjustments to the pre-STS 51-L data to allow the explanations of changes to be made without concurrent explanations of organizational changes.

KSC also identified areas where the SPC had been recently assigned responsibilities previously conducted by other KSC contractors. For example, LSOC will be performing certain logistics engineering tasks (for KSC equipment) which PRC previously performed. In addition, communications design tasks for the entire KSC operation have also been assigned to LSOC.

In Sustaining Engineering (design engineering), there are a number of tasks that were relating to troubleshooting and redesign of GSE/facilities, previously performed by PRC and civil service personnel. The original concept was that after PRC had completed the design and oversight of the implementation, SPC would only have to assume the maintenance of the equipment and facilities. KSC/Design Engineering (DE) now argues that the approximately 100 man-years of effort annually should be carried forward to the SPC. This is regarded by KSC as a "transfer," but the team believes it more appropriately reflects a change in the planned scope of work for the future.

The team also endeavored to determine and analyze the level of manpower required for "core" operations. The concept of a core addresses the key issue of the sensitivity of the manpower level to flight rate. After extended discussions, the team requested that KSC and LSOC rework their previous efforts in this direction to identify the manpower associated with a "minimum processing level." The groundrules provided by the team to KSC were stated as follows:

"All facilities open to support Shuttle operations which would be open during full-up processing except at appropriately reduced manning levels required to support one vehicle flow operations and 1 to 4 flights per year."

Data was also collected on a per-shift basis to identify the proportions of the work force working first, second, and third shifts.

Discussions with KSC personnel were held on experienced turn-around times, projected flight rate capability, and labor rates. The team discovered that the historical data base did not facilitate the analysis of the labor required for processing anomalies, orbiter mod traffic, change requirements, and "unplanned" work.

The team identified a number of areas in which changes in operating approach and assumptions have been made: Increased interaction with design centers and their element contractors; a return to having engineering presence on the OPF floor instead of having "supertechs" capable of interpreting work authorization documents; increased staffing levels to minimize overtime; more attention to the criticality of GSE, including going to a closed-loop OMRSD approach; emphasis on training the workforce, both on the job and in the classroom, including the use of simulation techniques for Launch Control Center (LCC) operators; the adoption of an "Apollo-type" QC inspector to OPF technician ratio (1:3.5); the adoption of a rigorous Orbiter structural inspection program; and greatly increased emphasis on the paper systems, from generation of work authorization documents to monitoring systems and formal pre-move reviews where open work papers have to be closed out.

SECTION 5
SHUTTLE PROCESSING CONTRACT

5.1 BACKGROUND

The Shuttle Processing Contract (SPC) was signed September 23, 1983 with a team headed by Lockheed Space Operations Company. The LSOC team is composed of LSOC, Grumman Aerospace, Morton Thiokol, and Pan American World Airways. The manpower figures referenced in this report cover the activities of the four team members.

In addition, there are currently seven minor subcontracts (booked as other direct costs) with Rocketdyne, Bionetics, EG&G, BAMSI, Unified Services, USBI, and Wiltech. Their total manpower amounts to approximately 300 persons.

After the contract award, the SPC gradually assumed the responsibilities of the incumbent contractors. The transition was completed by April 1984. The basic contract period was for three years, through September 1986. A firm option for an additional three years was also negotiated.

Although it was recognized at the time that the Space Shuttle was still in a developmental phase, NASA assumed that the Shuttle would evolve quickly into a relatively mature operational system. Airline-type operations were cited as an eventual goal, where processing operations and the supporting facilities and equipment would be standarized. This assumption carried with it the belief that the Space Shuttle program had to avoid constant reengineering to achieve rapid turnaround times and cost efficiencies. The degree of engineering involvement was to be minimized over time, and the typical aerospace reliance on pervasive quality control inspectors would also evolve to higher ratios of hands-on workers (technicians) to inspectors. Paperwork systems which were predominantly done by hand would be automated.

5.2 CONTRACT SCOPE

The areas of responsibility for the LSOC team are: Lockheed, prime; Grumman, Launch Processing System Operation and Maintenance (O&M); Morton-Thiokol, Solid Rocket Booster (SRB) and External Tank (ET) processing; and, Pan Am airline, methods and techniques. Lockheed is responsible for all Shuttle processing activities at KSC (and Vandenberg Air Force Base, under a separate schedule), including receipt, processing, directed modifications to and integration of all system elements (Orbiter, ET, solid rocket motors (SRM's), and SRB hardware) in preparation for launch; Orbiter to cargo integration and validation; launch, landing, and recovery operations (except for the SRB retrieval); and operation and maintenance and design modifications for assigned facilities, support equipment, and systems (such as communications).

KSC's intent over time has been to make the SPC "self-sufficient" by moving work previously performed by other contractors at KSC and Orbiter logistics responsibility to positions under the SPC. The scope of work assigned to the SPC has increased accordingly, with concomitant manpower increases. As an example, communications design and implementation activities have been recently assigned to the SPC, requiring an increase of 56 persons. This work was previously carried out by four contractors working for KSC's Design Engineering organization.

5.3 CONTRACT FORM

At inception, the SPC contract for the transition period October 1983 to March 1984 was a cost plus award fee (CPAF). From April 1984 to early 1986, the contract had a cost plus incentive fee/award fee arrangement. The incentive fee was based on the number of successfully completed missions, factored by the contractor's share of variances from the target cost. The latter was designed to create the incentive for a rapid transition to efficient operations. At the time of STS 51-L, LSOC was overrunning the target cost by about 10 percent. After STS 51-L, the change in the nature of the operations necessitated a change in the contract form to a fixed fee/award fee arrangement for the remaining period, through September 1986. The three-year follow-on contract has also been changed, to a CPAF with a maximum award fee of 8.5 percent.

The scope of work and the cost for the follow-on contract is now being negotiated with LSOC, with the manpower and cost reflecting the changes in the operational approach and philosophy as well as the launch rate. LSOC submitted a proposal for the scope of work, as understood in October 1986. Since that time, LSOC has revised its proposal several times to reflect further changes in the STS-26 launch date, additional scheduled work, and revised assumptions about the manning levels required to meet new program requirements. The current LSOC proposed manpower levels and the previous estimates are discussed below in Section 6.5.

5.4 REVIEWS OF SPC PERFORMANCE

As previously indicated, a number of groups have reviewed the KSC operations conducted under the SPC. These reviews led to findings of significant deficiencies in many areas. Correction of these deficiencies has, as already noted, led directly to increases in future manpower projections. The deficiencies listed below have been selected from the review groups' reports as having the largest impacts on SPC manpower requirements.

1. Excessive reliance on overtime over an extended period of time, leading to diminished workforce performance as worker fatigue became a factor.

2. Insufficient numbers of engineering personnel in an overall sense, and particularly a lack of subsystem processing engineerings being present in the immediate workplace (largely in the OPF).

3. Inadequate engineering involvement in vehicle processing planning and schedule integration.

4. Insufficient staffing of liaison engineering personnel for 7-day/3-shift (7/3) coverage at Vehicle Assembly Building (VAB) and the Space Shuttle Launch pads.

5. The lack of timely quality engineering availability at the launch control complex and pads.

6. Insufficient numbers of quality inspectors (QI's) and the lack of QI specialization.

7. The failure to anticipate potential future problems and areas requiring corrective actions due to not having done reliability engineering failure modes and effects analyses (FMEA's).

8. The need for simulation training of firing room personnel at subsystem and full-up integrated levels.

9. Cumbersome, poor-quality, inadequately disciplined paper systems; the need for revisions to Operations and Maintenance Requirements Specification (OMRS), Operations and Maintenance Instruction (OMI), and control documents.

10. The lack of timely problem-trend data; the lack of systems for overall quality measurement.

11. The lack of a closed-loop system for tracking and verifying requirements, including waivers and exceptions.

12. The failure to maintain currency on GSE OMRSD's and with less discipline, compared to flight vehicle OMRSD's.

13. The need for improved discipline and training of the technician workforce.

14. The failure to close open work and disposition open paper prior to key milestones (e.g., OPF rollout).

15. Insufficient involvement by design center contractors in all phases of operations.

5.5 LSOC MANPOWER ESTIMATES

As noted above, KSC and LSOC are currently negotiating the change (Change Order 143) to the previously definitized contract option for the October 1986 to September 1989 period of performance. KSC informed the team that the manpower levels proposed by LSOC in its October 1986 proposal were regarded by KSC as significantly understated. KSC's contract manager representatives (CMR's) believed that the proposed levels represented a top

management judgement which did not adequately reflect the concerns of LSOC's departmental managers.

As a result, the team met privately with LSOC management (Mr. Oppliger and Mr. Peasinger) on June 12, 1987. They indicated that the absence of a detailed understanding of the changes in operational approach and requirements had led them to reject the submissions from their department heads in favor of a parametrically-derived estimate. The difference in FY 1989 average staffing levels was approximately 1,000 in headcount - 7,000 for the parametric estimate vs. 8,000 from the department heads. (These figures include all fund sources and directs, not just Shuttle operations.) LSOC has since submitted revised proposal of 7,267 and plans to incorporate further changes to bring the total to about 7,500. These changes reflect a series of discrete requirements changes as well as an improved understanding of the engineering, data systems, and Safety, Reliability, and Quality Assurance (SR&QA) tasks. Although differences at the departmental level still exist with the KSC Contract Manager Representative (CMR) evaluations, the total levels are consistent with KSC's estimate of a 7,512 manning level for FY 1990.

It is worth noting that both LSOC and KSC management agree completely that the manning levels should be predicated on an assumption that the flight hardware, facilities, and equipment will experience continuing high modification rates. The LSOC representatives also indicated that the assumption of a 1 percent overtime rate across the total workforce in FY 1990 is probably unrealistic. They expect the overtime rates to increase, reflecting the desire for improvements in vehicle processing flowtimes.

SECTION 6
CHARACTERIZATION OF THE WORKFORCE

6.1 OVERVIEW

A description of the workforce and how it is tailored to support Shuttle processing operations is required to understand the SPC manpower drivers and the workforce sensitivity to flight rate. This description includes kinds and distribution of skills, shifting methods and overtime rates, and changes in the character of the post-STS 51-L operations. This description is preceded by some of the underlying assumptions about the nature of the processing operations and what distinguishes them from other production operations, such as an assembly line.

6.2 ASSUMPTIONS USED TO TAILOR THE WORKFORCE

As the responsible center for launch and landing operations, KSC has facilities which, depending upon fleet size, are capable of achieving a given flight rate. The SPC workforce is tailored to man these facilities as necessary to produce those flights. The maximum flight rate is dependent upon the turnaround time (TAT), the facilities, and the fleet size. The TAT, exclusive of mission and landing-site-to-launch-site transportation time, is a function of the serial processing time required as the vehicle and payload are processed through the OPF, the VAB, and the pad. since mission and transportation are relatively small time increments, processing time represents the critical path for achieving the maximum flight rate.

Theoretically, maximum operational efficiency in a multi-vehicle operation is realized by creating a mix of vehicles, facilities, and personnel levels such that all processing operations are on the critical path simultaneously. Idle time would be nil. That type of efficiency can be realized only if processing times can be predetermined with sufficient advance notice. As a result of modification (mod) traffic and special test requirements, that has not been the case with the NSTS program, and there is no reason to believe that this historical problem will not continue for at least the next few years. It is certainly the largest single driver for flight rate.

Experience indicates that the time required to process the Orbiters through the OPF governs the flight rate, as shown in Table 6-1. Not counting first flows and major mods of orbiter vehicles, the OPF times for previous flights average 44 workdays, with a standard deviation of 18 days. The VAB has typically run 7 days, with a standard deviation of 3 days, and the pad, 25 days, with a standard deviation of 13 days. The OPF processing time, however, is determined by the amount of recurring and nonrecurring operations (mods, special test requirements) required. Fully manning this facility is essential to assure that the recurring and nonrecurring operations consume the least possible time. The manpower levels are, therefore, more a function of optimizing the utilization of this facility, with flight rate being a product of the processing requirements.

TABLE 6-1.- SPACE SHUTTLE ORBITER PROCESSING RATE

Flight	date	OPF days	VAB days	PAD days
1	4-12-81	F531	F33	F104
2	11-12-81	99	18	70
3	3-22-82	55	12	30
4	6-27-82	41	7	29
5	11-11-82	48	9	45
6	4-4-83	F123	F6	F115
7	6-18-83	34	5	21
8	8-30-83	26	4	25
9	11-28-83	82	12	34
41-B	2-3-84	52	6	22
41-C	4-6-84	31	4	18
41-D	8-30-84	F123	F15	F72
41-G	10-5-84	53	5	22
51-A	11-8-84	34	5	17
51-C	1-24-85	31	5	20
Scrub		57	5	20
51-D	4-12-85	53	5	15
51-B	4-29-85	31	4	15
51-G	6-17-85	37	7	14
51-F	7-29-85	39	5	31
51-I	8-27-85	27	7	22
51-J	10-3-85	F84	F14	F34
61-A	10-30-85	35	4	14
61-B	11-26-85	27	4	15
61-C	1-12-86	M103	M6	M34
51-L	1-28-86	31	5	28
Average days		44	7	25
Standard deviation		18	3	13

F - FIRST FLIGHT OF VEHICLE
M - FIRST FLIGHT FOLLOWING MAJOR MOD

NOTE: The average days and standard deviation figures are exclusive of first flights and major mod flows.

Accordingly, the processing workforce must be capable of supporting an around-the-clock operation at all times in the OPF.

More flexibility is assumed in the VAB and pad operations, where surge requirements predominate, and in areas like payload integration. In these areas, manpower levels sufficient to support 5-day/2-shift (5/2) operations are usually required, with surge requirements handled by cross-utilization and swing shifting. On one of the pads, for example, operations requiring 7/3 schedules can be accommodated by using personnel from the other pad, temporarily suspending mods and pad maintenance.

6.3 DISTRIBUTION OF THE WORKFORCE ACROSS FACILITIES

Although the OPF, the VAB, and the pads are focal points, the manpower in these facilities comprises only a fraction of the total workforce required to process the Space Shuttle. Table 6-2 shows the distribution of SPC manpower at KSC.

6.4 SENSITIVITY OF WORKFORCE REQUIREMENTS TO FLIGHT RATE

Although flight rate is the product of the SPC, in fact the manpower requirements are driven only secondarily by the number of flights. The real driver is the mix of facilities required to support processing operations. Flight rate depends, therefore, upon the set of serial flow requirements that must be satisfied in each of the facilities on the critical path.

One purpose of this study, however, was to understand the sensitivity of the workforce to the flight rate. In other words, if the flight rate were to be reduced from 12 flights per year to 10 (or increased a like amount), what affect would there be on the manpower requirements? Accordingly, a fixed vs. variable workforce analysis was conducted. This analysis required assumptions on a given set of facilities to define what constituted some (arbitrarily defined) minimum processing posture for KSC. Manpower estimates were provided by KSC and SPC for this minimum, based on having an "open for business" facility set, which in turn defined a minimum flight rate. The definitions are as follows:

a. Minimum Processing Level (Open for Business) - All facilities open to support Space Shuttle operations which would be open during full-up processing except at appropriately reduced manning levels required to support flow operations for one vehicle and 1 to 4 flights per year.

   Assume the following:

   (1) One OPF bay for processing and a second bay in a facilities maintenance/mod status

   (2) One VAB bay for processing a Space Shuttle vehicle (SSV) and a second bay in a facilities maintenance/mod status

TABLE 6-2.- SPC PERSONNEL DISTRIBUTION BY SITE
AS OF JUNE 1987

No.	Organization:	OPF	VAB	Pads & prop	LCC	VAB complexes	Indust area	Other
	Total LSOC/SPC	605	1083	404	676	807	776	1117
11-XX	Shuttle Data Systems		13		10	247		13
13-XX	Human Resources						62	
15-XX	Shuttle/Payload Integration		7	2		82		
16-XX	Operations Control (LCC)	30	1	3		22	53	18
17-XX	Shuttle & Grnd Supt Engrng	141	382	15		225	19	163
18-XX	Business Management		5		14	28	112	1
20-XX	KSC Operations	382	406	66	114	107		88
24-XX	Morton Thiokol Operations		48				20	34
30-XX	Support Operations	1	126	242	83	89	378	299
31-XX	Grumman/LPS		12	7	258		91	25
40-XX	Logistics	39	22	4			29	268
50-XX	SRM&QA	12	60	24			11	113
	Other		1	41	197	7	1	95

(3) One pad in processing and a second pad in a facilities maintenance/mod status

(4) Five-days-per-week/2 power-on shift operations in the OPF, the VAB and the pad, except as necessary during launch, hazardous, and other critical operations.

(5) Other assumptions you may require to characterize your workforce in support of this minimum-level operation.

(6) Two other Orbiters at KSC (not in flow and not in mod) but meeting OMRSD requirements; positioned in the VAB or OMRF.

b. Core Work Force - The portion of the SPC workforce (Shuttle operations, direct EP) required to support the launch and landing facilities when operating at the "minimum processing level."

c. Maximum Processing Complement - The additional complement of manpower required to increase the capability of the launch and landing facilities from minimum processing level to maximum capacity.

d. Maximum Capacity - For any given set of processing requirements, maximum capacity indicates the processing rate that utilizes the existing buildings, facilities, and fixtures to the maximum extent possible to prepare, launch, and recover Space Shuttle missions.

Assume the following:

(1) Two OPF bays processing vehicles with facilities maintenance/mods being conducted in parallel. Seven-day/3-shift operations (2 shifts, power on; 1 shift, power off).

(2) The OMRF facility is available with safing/deservicing capability.

(3) Two vehicles in flow, plus one vehicle in flight or recovery/deservice status, and a fourth vehicle in a preparation (prep), mod, or wait state.

(4) Two vehicles in the VAB with facilities maintenance/mod conducted in parallel. A 5-days-per-week/2-shift operation with both pads in operation.

(5) One vehicle on a pad at a time, and the second pad in a facilities maintenance/mod status.

(6) Other assumptions as you may require to characterize maximum processing capability.

The responses from the SPC organizations indicated that the level of core manpower amounted to 5,650 in FY 1990. As indicated from the definitions above, this represents the "open for business" level of manpower. To get to the rate of one launch per month, an additional 1,862 personnel were judged to be required. An organization breakdown of this level of manpower is exhibited in Table 6-3.

TABLE 6-3.- SPC MANPOWER BOTTOMS-UP REVIEW SHIFTING ASSUMPTIONS FOR FY 1990

No.	Organization	Shifting			Core	Additional processing
		1	2	3		
	SPC total contract	5333	1398	781	5650	1862
XX-XX	Business Management	321	5	0	326	0
11-XX	Shuttle Data Systems	461	12	12	457	28
15-XX	Shuttle/Payload Integration	108	21	12	141	0
16-XX	Operations Control	366	58	35	328	131
17-XX	Shuttle & Ground Support Engineering	929	155	82	871	295
20-XX	Operations	602	368	186	1001	155
24-XX	Morton Thiokol	276	137	67	159	321
30-XX	Support Operations	960	248	127	998	337
31-XX	Grumman/LPS	442	162	141	550	195
40-XX	Logistics	456	60	32	355	193
50-XX	SMR&QA	412	172	87	464	207

6.5 THE RELATIONSHIP OF SHIFTING ASSUMPTIONS TO MANPOWER

a. Background - In the six months prior to STS 51-L, the SPC workforce in key areas worked around-the-clock, seven days a week. Using December 1985 data as a benchmark, the number of employees actually assigned to the second and third shifts represented 13 percent and 5.5 percent of the total workforce. In the OPF, the second and third shifts amounted to 25 percent and 12 percent of the 634 total employees. This characterization is misleading, however, due to the large amount of overtime being worked. In the OPF, overtime in November and December 1985 averaged 28 percent and 22 percent, respectively. Overtime for supporting engineering, quality, support technicians, LCC firing room, and program planning and control personnel were also necessarily high. Figure 6-1 illustrates the workforce overtime data for the six month period prior to STS 51-L.

The efficiency of the workforce was impacted not only by the negative effects of working prolonged stints on overtime, but also by the high levels of unplanned work, including modifications and processing anomalies or incidents. The post-STS 51-L review committees concluded that the workforce manning levels were simply inadequate to conduct safe, effective operations on the second and third shifts.

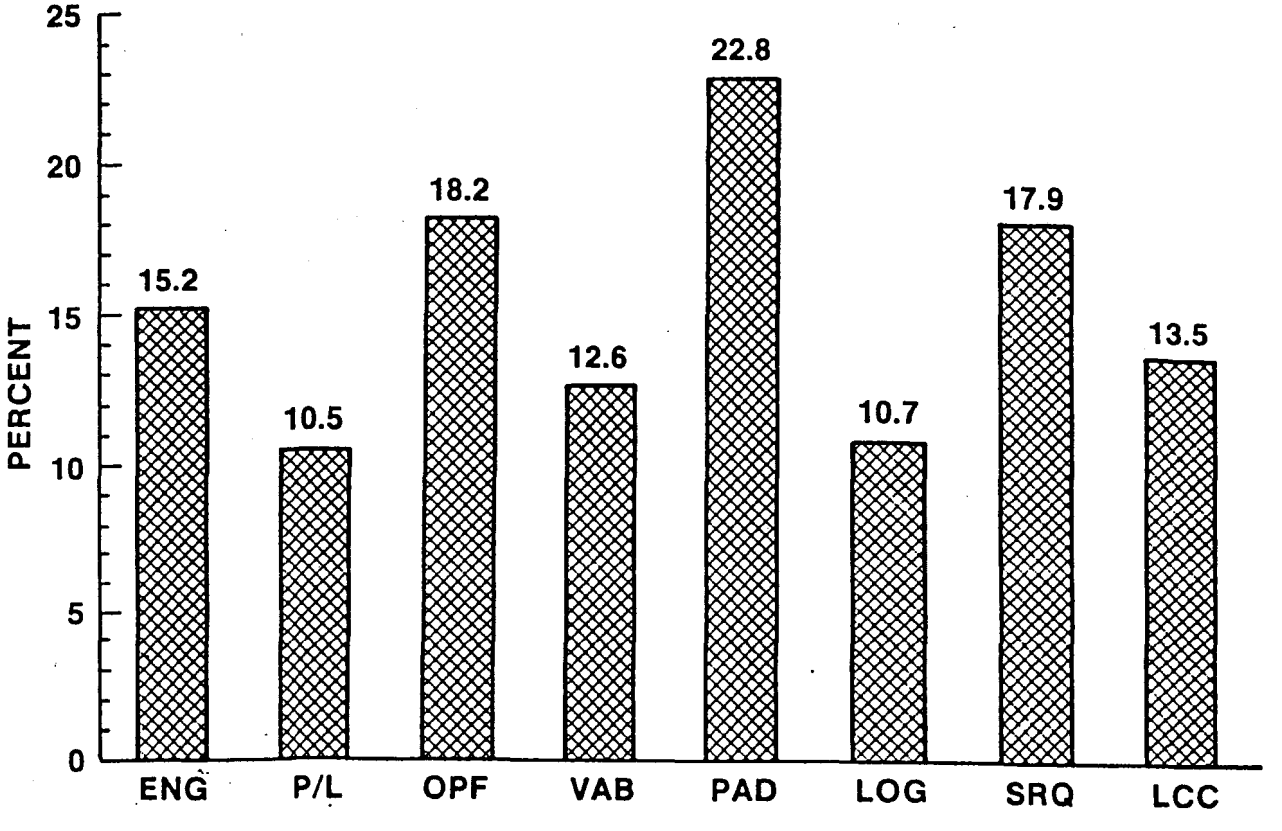

Figure 6-1.- Average overtime for August 1985 to January 1986.

TABLE 6-4.- SPC manning levels.

	LSOC	Grumman	Thiokol	Total
December 1985	5061	769	440	6270
1st shift	4319	509	293	5121
2nd shift	551	144	108	803
3rd shift	191	116	39	440
FY 1990	6285	745	482	7512
1st shift	4609	442	282	5333
2nd shift	1099	162	137	1398
3rd shift	577	141	63	781

b. Current Shifting Plans - The increased manning levels for the SPC as a whole show significant differences when compared to the December 1985 data on a per-shift basis, as shown in Table 6-4.

The percentage increases For LSOC for the three shifts compute to 7 percent, 99 percent, and 302 percent, respectively. This is a headcount comparison, and it reflects the increase in manning levels to reduce overtime. (A comparison of equivalent manpower working each shift before STS 51-L is not available. We were informed that the overtime data as applied against each shift is not available for the pre-STS 51-L period.)

The change in approach is planned to be accomplished with odd work weeks (Monday through Saturday and Tuesday through Sunday) to enable weekend coverage and swing shifting, as well as augmented second and third shift manning for the standard work week. The key concern is to provide sufficient coverage on a 7-day/3-shift (7/3) basis in the critical path facilities while managing overtime at low levels. As indicated above, the OPF workforce and the supporting personnel are always in the critical path. The VAB and the pads become critical paths for distinct, relatively short periods during each flow. Figure 6-2 shows the planned shift distribution for FY 1990 by organization.

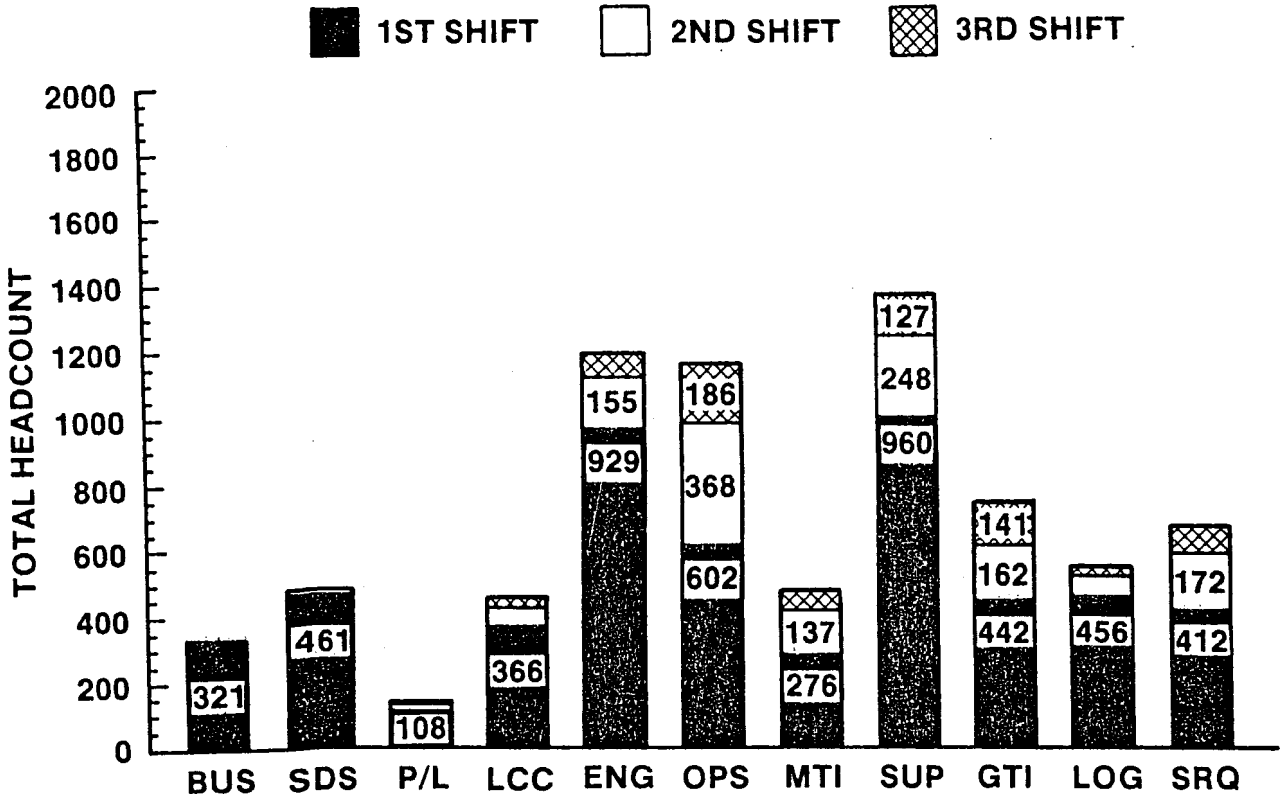

Figure 6-2.- Shift distribution in FY 1990.

c. OPF Shifting - In FY 1990, the OPF will be working 7/3's, with two shifts powered up, for continuing processing operations. Non-critical path operations (such as mods, structural inspections, and GSE work) are expected to be workable on a 5/3 or 6/3 basis. An early approach to providing 7/3 coverage was to have seven subcrews on an odd work week schedule, i.e., approximately 500 of the projected level of 690 people (the total manning for the OPF and supporting landing site operations) would be working on any given day. This "rolling wave" approach has since been modified. LSOC is now leaning toward having about 3 subcrews working odd work weeks. Since a 7-member subcrew, enabling a full-up 7/3 approach, involves increasing the manning levels in all the supporting elements as well, i.e., LCC operators, process engineering, support technicians, quality, and program planning and control, this is an affordability issue on one side and a question of effectiveness on the other. The effectiveness issue involved the consideration of incurring a large amount of non-productive time whenever process operations are such that only a small number of the workforce can be utilized for given operations, such as hazardous operations, rollout preparations, etc. An example of why this appears reasonable is that the rules governing hypergol operations in the OPF have been changed so that both bays of the OPF now have to be cleared when hypergol operations are being conducted in one bay. Consequently,

LSOC intends to utilize the weekends to the maximum extent possible for such operations. However, the modified approach allows for weekends to be used to work critical path operations, with the potential for altering workforce shifting plans and using overtime when deemed desirable.

The other aspect of the original "rolling wave" approach was to have three relatively equal (in terms of technician manning) shifts per day. The rationale of using the third shift as a power-on operation vs. the current plan of having only the first two shifts power-on is as follows: In the past the third shift has been scheduled for light activity and limited power-on activity, even though delays in the first two shifts' processing operations resulted in higher activity levels. LSOC would prefer to have the third shift make preparations for the first shift in an attempt to avoid the past experience of having delayed starts in processing operations on the first shift.

d. VAB/Pad Shifting - The operations in the VAB are scheduled for 6/3's, but the manning levels provide the capability of executing 7/3's when continuous operations are required, such as SRB stacking and stacked vehicle processing. The workforce on both pads is scheduled for non-critical path operations on a 5/2 basis. some third shift work is conducted as needed. When the vehicle is in final launch preparations, the pad being used will work 7/3's, cross-utilizing manpower from the other pad.

e. Supporting Elements - As is commonly the case in aerospace operations, the bulk of the manpower supports the hands-on technicians. For example, the Launch Control Complex firing rooms have to be active when power-up testing is conducted. Firing room and software support is consequently tuned to match processing operations. LCC systems validation manpower is not, and thus is planned to only work 5/2's. A key pre-STS 51-L issue was the availability of process engineering support to resolve problems which arose during non-first-shift testing. As noted above, LSOC estimates provide for substantially increased manpower to support the operational concept being employed in the OPF for processing. The same holds true, but to an even greater extent, for the personnel doing O&M of processing facilities, working in support systems or in shops and labs. The absence of personnel such as electricians on the third shifts and on weekends was cited by LSOC as an example of problems introduced into processing operations when the OPF, GSE, or other systems went down and processing was delayed while support personnel called from home came in to resolve the problems. LSOC now plans for personnel in critical areas to be working 7/3's, compared to the 5/2 shifting approach and the extensive overtime employed prior to 51-L. Although the bulk of the manpower will continue to be utilized on the first shift, figure 2 indicates that over 1,000 individuals in supporting elements will work the second shift, and almost 600 will work the third. This is a support-to-hands-on ratio of about three to one.

5 EFFECTS OF UNPLANNED WORK

A large percentage of the work that must be done during each sequence of Space Shuttle flight-preparation procedures (flow) is historically unplanned. "Unplanned" means it is not possible to plan and schedule the tasks in question before the flow begins. The magnitude of unplanned work is such that it is a significant driver in the sizing and constitution of the SPC workforce - technicians, engineering, and support.

Given the resources, the effects of unplanned work are primarily schedule changes, even though major milestones are usually met. The schedule changes at the detail level require flexibility of resources in terms of technicians and their various skills, engineers for the preparation of work paper, planners and schedulers, quality, logistics, and other support. An examination of an "as run" schedule compared to a pre-flow schedule in no way reflects the tremendous effort involved in the evolution from one to the other. It can be argued that at a detail level unplanned work takes a heavy toll on resources and may lead to error. The portion of unplanned work which can be controlled should be more carefully considered by the program.

The SPC workforce planning was based on KSC experience, which includes unplanned work as a major driver. A conservative definition of unplanned work is: modifications defined after LSFR, special requests approved after LSFR, changes to OMRSD's, and all problem reports, interim problem reports, and discrepancy reports. Several studies have been carried out on unplanned work, examining different elements of the above definition. The material below addresses three studies on unplanned work and a case study. Emphasis is on OPF operations because the quantity of unplanned work is greatest there.

a. Time card data was examined in one study done on STS 24-31. Total vehicle-technician manhours in the OPF were computed for a flow, excepting all GSE and TPS work. The manhours for a "standard" flow were computed, and the difference was considered to be unplanned work. This study showed that an average of 39 percent of technician hours was spent on non-standard tasks, ranging from a low of 23 percent to a high of 53 percent. The engineering manpower percentage data was not available, but would probably be even higher for nonstandard tasks.

b. The number of tasks conducted during the flows of STS 28-33 was examined as another indicator. In this study, all Operations and Maintenance Instructions (OMI's) and job cards were considered standard tasks, and all TPS's, PR's, and DR's were considered nonstandard. Using this definition, 49 percent of Orbiter stand-alone jobs were non-standard, ranging from a high of 72 percent to a low of 34 percent. Of the entire flow, 37 percent was nonstandard (high 56 percent, low 24 percent).

c. Using data from STS 31-33, there are an average of 24 late special requests, 18 Requirements Change Notices (RCN's), and 677 PR's per flow.

One case study was examined which seemed most representative of th effects of unplanned work. The sequence of events was recorded ir NASA operations log. The full impact of a mod was not initially understood. Once the mod was started, a second-opportunity mod was identified. Several PR's surfaced, eventually becoming the critical path. Finally, an incident occurred which might not have happened had there been less schedule pressure. Paper had to be rewritten, and several decisions required other center coordination. Finally, this path plus other systems working independently of this path all were being driven by the payload bay doors closure date.

In summary, it can be said that there is no single, easy set of statistics that can accurately capture the impact of unplanned work on Shuttle processing. From KSC's experience base, the percentages have been high. The workforce planning for the future has been based on anticipating the same sort of unplanned work in the future as has been experienced in the past.

6.7 CHANGES IN THE OPERATION SINCE STS 51-L

As stated earlier, the findings of the external investigative committees together with KSC's internal self-evaluation have resulted in significant changes to the Shuttle processing operation. The effects of their findings and recommendations on SPC manpower amounts to added discipline in the flight vehicle processing and caring for associated ground systems. This added discipline has been manifested as additions to manpower in the areas of engineering support to the on-line workforce, additional quality control, and increased emphasis on planning and control of work. Figure 6-3 illustrates this effect on the major categories of the SPC contract. Offline support manpower has increased somewhat, indicating both transfers of tasks to LSOC and new requirements, such as the enhanced, closed-loop OMRSD accounting to be used for GSE maintenance. In process engineering support, the significant increase in manning levels is a result of several factors, the most obvious of which is increased engineering support to the hands-on workforce. However, some other, more subtle requirements are as follows:

- More engineers to handle problem resolution and to change traffic during the flows.
- Increased engineering attention to critical ground systems.
- Increased interface requirements with design centers.
- Increased Orbiter structural inspections and test requirements.

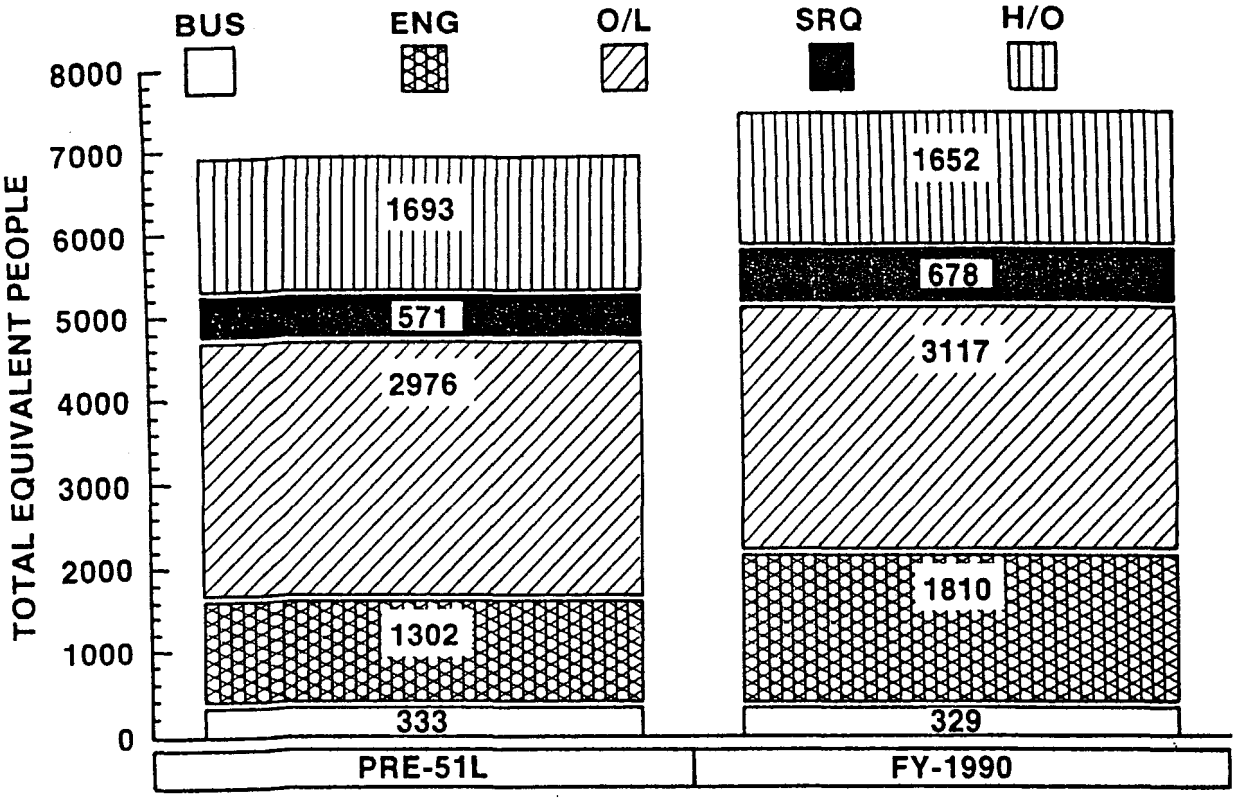

Figure 6-3.- Workforce characterization.

In the SRM&QA area, the increase reflects the enhancements to the processing QC inspector-to-technician ratios. These ratios will be higher than pre-STS 51-L levels and roughly equivalent to pre-SPC ratios. For example, in the OPF, the pre-STS 51-L ratio was 1:4 and is now planned to be 1:3.5. In addition, safety and reliability documentation, surveillance, and reporting are being enhanced across the operation to improve the SRM&QA organization's participation in the program change control, OMRSD, Operations and Maintenance Instruction (OMI), problem reporting, and performance measurement processes.

Finally, it is worthwhile to point out that although there is an increase in the absolute manning levels for hands-on personnel between the two periods, the same comparison on an equivalent-person basis, where overtime has been factored in, shows a decrease. The explanation given for this decrease by LSOC is that the augmented levels of personnel directly supporting hands-on operations will yield a more efficient and effective operation.

The overall conclusion of the team is that the revised manning levels and changes in operational approach are the result of increased conservatism and an effort to add discipline to the system. The underlying philosophical change is that the pre-STS 51-L resistance to abandoning the concept of progressing from a Research and Development (R&D) operation to an "airlines-type" operation has been overcome by the realization that the key elements of the STS system do not lend themselves to a routine operational approach.

SECTION 7
DETAILED DESCRIPTION OF THE WORKFORCE

7.1 OVERVIEW OF TOTAL CONTRACT AND DIVISIONAL BREAKDOWN

In this section, you will find Figure 7-1, an SPC organizational chart, followed by table 7-1, an SPC manpower bottoms-up analysis of each organization.

NOTE: The detailed manpower numbers may differ from the summary manpower levels due to rounding.

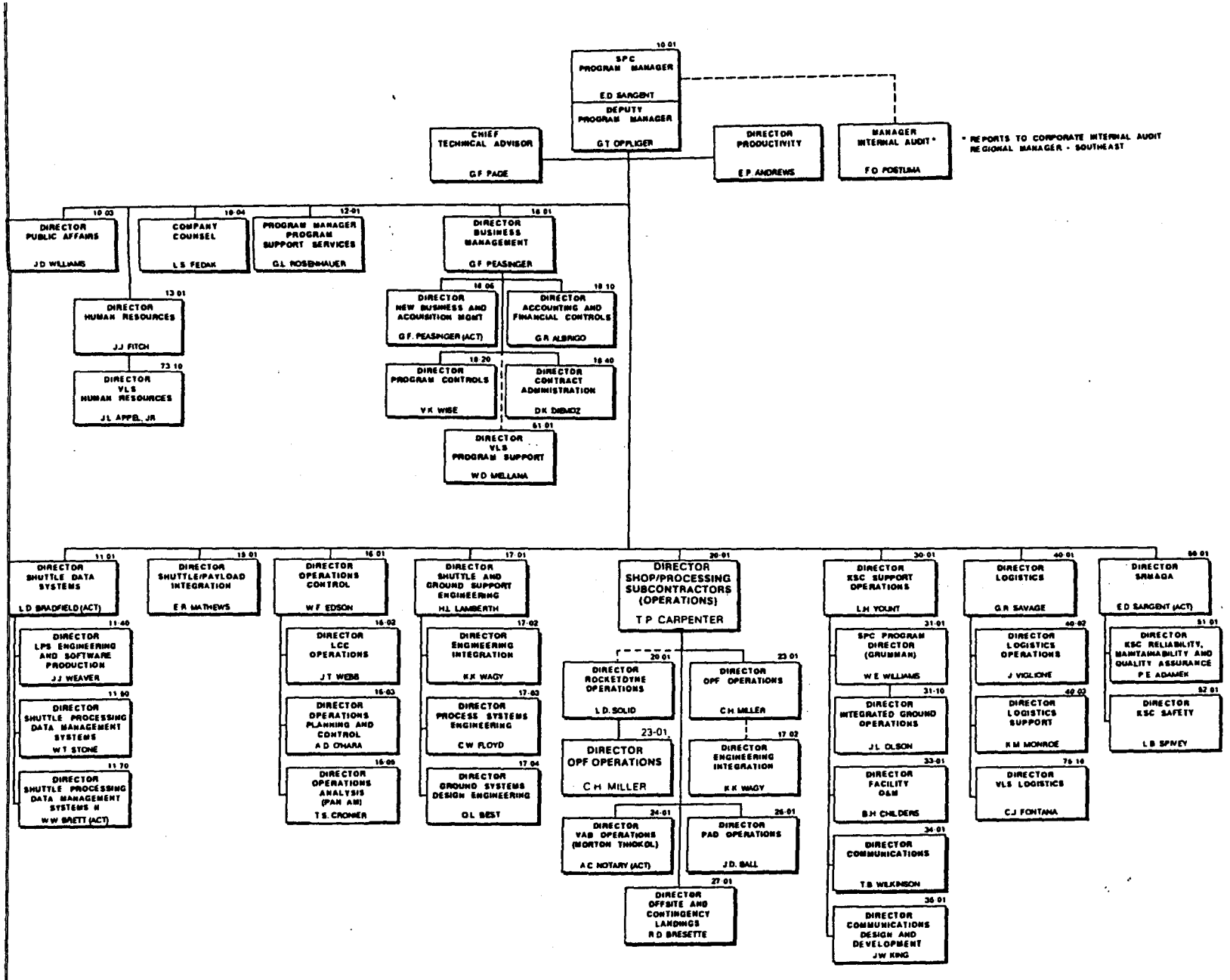

Figure 7-1.- SPC organizational chart.

TABLE 7-1.

(A) SPC MANPOWER DATABASE BOTTOMS-UP ANALYSIS SPC SUMMARY

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
	SPC TOTAL CONTRACT	1.12	6117	6875	7512	7587	1395	712
XX-XX	BUSINESS MANAGEMENT	1.02	326	333	326	329	0	-4
11-XX	SHUTTLE DATA SYSTEMS	1.12	410	460	485	490	75	30
15-XX	SHUTTLE & PAYLOAD INTEGN	1.11	107	117	141	142	34	25
16-XX	OPERATIONS CONTROL/PAA	1.13	345	389	459	464	114	75
17-XX	SHUTTLE & GRND SPT ENGRG	1.13	647	725	1166	1178	519	453
20-XX	KSC OPERATIONS	1.18	1050	1243	1156	1167	106	-75
24-XX	MORTON THIOKOL OPERTIONS	1.13	400	450	480	485	80	35
30-XX	SUPPORT OPERATIONS	1.15	1060	1220	1335	1348	275	128
31-XX	GRUMMAN/LPS	1.04	702	729	745	752	43	23
40-XX	LOGISTICS	1.10	581	638	548	553	-33	-85
50-XX	SRM&OA	1.17	489	571	671	678	182	106

(B) SPC MANPOWER DATABASE BOTTOMS-UP ANALYSIS PRE-51L

NO.	ORGANIZATION:	OVERTIME RATE	AVE HEADCOUNT	AVE EP	INDIRECTS	REIMB	TOTAL DIRECT	LNCH OPS DIRECT
	SPC TOTAL CONTRACT	1.13	6117	6875	413	440	6462	6022
XX-XX	BUSINESS MANAGEMENT	1.02	326	333	177	22	156	134
11-XX	SHUTTLE DATA SYSTEMS	1.12	410	460	5	34	455	421
15-XX	SHUTTTLE/PAYLOAD INTEGN	1.10	107	117	4	0	113	113
16-XX	OPERATIONS CONTROL	1.13	345	389	11	0	378	378
17-XX	SHUTTLE & GRND SPT ENGRG	1.12	647	725	18	92	707	615
20-XX	OPERATIONS	1.18	1050	1243	26	10	1217	1207
24-XX	MORTON THIOKOL	1.13	400	450	20	0	430	430
30-XX	SUPPORT OPERATIONS	1.15	1060	1220	21	174	1199	1025
31-XX	GRUMMAN/LPS	1.04	702	729	20	103	709	606
40-XX	LOGISTICS	1.10	581	638	85	5	553	548
50-XX	SRM&OA	1.17	489	571	26	0	545	545

= EP - Indirects

= Direct - Reimb

= 6462 - 440

TABLE 7-1.- CONTINUED

(C) SPC MANPOWER
BOTTOMS-UP ANALYSIS
FY1990

NO.	ORGANIZATION:	PROJ'D HEADCOUNT	AVE EP	INDIRECTS	REIMB	TOTAL DIRECT	LNCH OPS DIRECT
	TOTAL SPC CONTRACT	7512	7587	430	237	7157	6920
XX-XX	BUSINESS MANAGEMENT	326	329	184	22	145	123
11-XX	SHUTTLE DATA SYSTEMS	485	490	7	21	483	462
15-XX	SHUTTTLE/PAYLOAD INTEGN	141	142	4	0	138	138
16-XX	OPERATIONS CONTROL	459	464	12	0	452	452
17-XX	SHUTTLE & GRND SPT ENGRG	1166	1178	17	16	1161	1145
20-XX	OPERATIONS	1156	1167	28	0	1139	1139
24-XX	MORTON THIOKOL	480	485	21	0	464	464
30-XX	SUPPORT OPERATIONS	1335	1348	23	73	1325	1252
31-XX	GRUMMAN/LPS	745	752	22	103	730	627
40-XX	LOGISTICS	548	553	86	2	467	465
50-XX	SMR&OR	671	678	26	0	652	652

(D) SPC MANPOWER
BOTTOMS-UP ANALYSIS
SHIFTING ASSUMPTIONS
FY1990

NO.	ORGANIZATION:	SHIFTING 1	SHIFTING 2	SHIFTING 3	CORE	ADD'L PROCESSG
	SPC TOTAL CONTRACT	5333	1398	781	5650	1862
XX-XX	BUSINESS MANAGEMENT	321	5	0	326	0
11-XX	SHUTTLE DATA SYSTEMS	461	12	12	457	28
15-XX	SHUTTTLE/PAYLOAD INTEGRATION	108	21	12	141	0
16-XX	OPERATIONS CONTROL	366	58	35	328	131
17-XX	SHUTTLE & GRND SPT ENGRG	929	155	82	871	295
20-XX	OPERATIONS	602	368	186	1001	155
24-XX	MORTON THIOKOL	276	137	67	159	321
30-XX	SUPPORT OPERATIONS	960	248	127	998	337
31-XX	GRUMMAN/LPS	442	162	141	550	195
40-XX	LOGISTICS	456	60	32	355	193
50-XX	SMR&OR	412	172	87	464	207

TABLE 7-1.- CONTINUED

(E) SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
	TOTAL SPC	1.124	6117	6875	7512	7587	1395	712
XX-XX	BUSINESS MANAGEMENT	1.021	326	333	326	329	0	-4
10-XX	PROGRAM MANAGER & STAFF		24	25	25	25	1	0
13-XX	HUMAN RESOURCES		70	71	70	71	0	0
18-XX	BUSINESS MANAGEMENT		232	237	231	233	-1	-4
11-XX	SHUTTLE DATA SYSTEMS	1.12	410	460	485	490	75	30
11-01	Mgt & Staff		0	0	2	2	2	2
11-4X	LPS ENG & S/W PROD MGT		272	310	290	293	18	-17
11-5X	FACILITIES O & M		62	63	112	113	50	50
11-6X	DATA SYS INTEGRATION		76	87	81	82	5	-5
15-XX	SHUTTLE/PAYLOAD INT	1.10	107	117	141	142	34	25
15-01	DIR, SHUTTLE/PL INT	1.10	8	9	4	4	-4	-5
15-10	CENTAUR PROJECT	1.10	2	2	3	3	1	1
15-20	SHUTTLE/PL INT OPS	1.10	21	23	26	26	5	3
15-30	SHUTTLE/PL INT ENG	1.10	48	53	65	66	17	13
15-40	SHUTTLE/PL REQMTS & INT	1.10	28	31	43	43	15	13
16-XX	OPERATIONS CONTROL	1.13	345	389	459	464	114	75
16-01	OPERATION CONTROL STAFF		0	0	6	6	6	6
16-02	LCC OPERATIONS		68	76	108	109	40	33
16-03	PROCESS PLANNING & CTL		261	295	330	333	69	38
20-XX	PAA/OPERATIONS ANALYSIS		16	18	15	15	-1	-3
17-XX	TOTAL ENGINEERING	1.12	647	725	1166	1178	519	453
17-0X	MANAGEMENT & STAFF		23	24	29	29	6	5
17-1X	PROJ ENGRG & TEST INT		52	61	90	91	38	30
17-2X	ELECT/MECHANICAL SYS ENG		237	271	371	375	134	104
17-5X	FLUID/MECHANICAL SYS ENG		194	221	331	334	137	113
17-60	ENGINEERING TECHNOLOGY	1.00	5	5	6	6	1	1
17-70	SITE LIAISON	1.11	9	10	27	27	18	17
17-8X	PROJECT MANAGEMENT		46	49	115	116	69	67
17-9X	DESIGN ENGINEERING		81	84	197	199	116	115
2X-XX	KSC OPS DIRECTORATE	1.183	1050	1242	1156	1167	106	-75
20-01	KSC OPS DIRECTOR	1.018	12	12	8	8	-4	-4
23-XX	OPF		606	709	582	588	-24	-121
26-XX	PRD		406	491	462	467	56	-24
27-XX	OFFSITE LANDING/RECOVERY		26	30	104	105	78	75

TABLE 7-1.- CONCLUDED

(E) CONCLUDED

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
24-XX	MORTON THIOKOL OPS	1.13	400	450	480	485	80	35
24-01	DIR, VAB OPS - SRB				2	2	2	2
24-10	MANAGEMENT & STAFF	1.12	7	8	10	10	3	2
24-30	Quality Assurance	1.18	63	74	88	89	25	15
24-40	Safety	1.13	13	15	20	20	7	6
24-50	ET/SRB PROCESSING	1.12	203	226	224	226	21	0
24-60	SRB RETRL/DISASSEMBLY	1.12	77	86	93	94	16	8
24-80	PROCESS SUPPORT	1.12	37	41	43	43	6	2
3X-XX	SUPPORT OPERATIONS	1.15	1060	1220	1335	1348	275	128
30-01	DIRECTOR		11	11	11	11	0	0
33-XX	FACILITIES O & M		672	801	853	862	181	61
34-XX	COMMUNICATIONS		317	344	368	372	51	28
35-XX	COMMUNICATIONS DESIGN		25	26	56	57	31	31
36-XX	TEST SUPPORT MGMT OFC		35	37	47	47	12	10
31-XX	GRUMMAN/LPS	1.04	702	729	745	752	43	23
31-00	BUSINESS OPS		37	37	30	30	-7	-7
31-1X	TEST SPT SPECIAL PROJECTS		45	47	43	43	-2	-4
31-2X	LPS O&M		313	326	334	337	21	11
31-3X	INSTRUMENTATION CAL		99	103	132	133	33	30
31-4X	ENGINEERING SPT		208	216	206	208	-2	-8
40-XX	LOGISTICS	1.10	581	638	548	553	-33	-85
40-0X	DIR, LOGISTICS		41	42	21	21	-20	-21
40-3X	SUPPLY SUPPORT		298	336	237	239	-61	-97
40-4X	LOGISTICS ENGINEERING		85	88	131	132	46	44
40-5X	PROCUREMENT		65	72	51	52	-14	-20
40-6X	TRANSPORTATION		65	72	52	53	-13	-19
40-7X	TECHNICAL TRAINING		27	28	56	57	29	29
50-XX	SRM&QA	1.17	489	571	671	678	182	106
50-01	SRM&QA DIRECTORATE	1.04	12	12	13	13	1	1
51-XX	RM&QA		408	481	575	581	167	100
52-XX	SAFETY		69	78	83	84	14	6

7.2 XX-XX BUSINESS MANAGEMENT

In this section you will find figure 7-2, a Business Management organizational chart, followed by table 7-2, a manpower bottoms-up analysis of Business Management, and by Table 7-3, a Business Management breakdown by department.

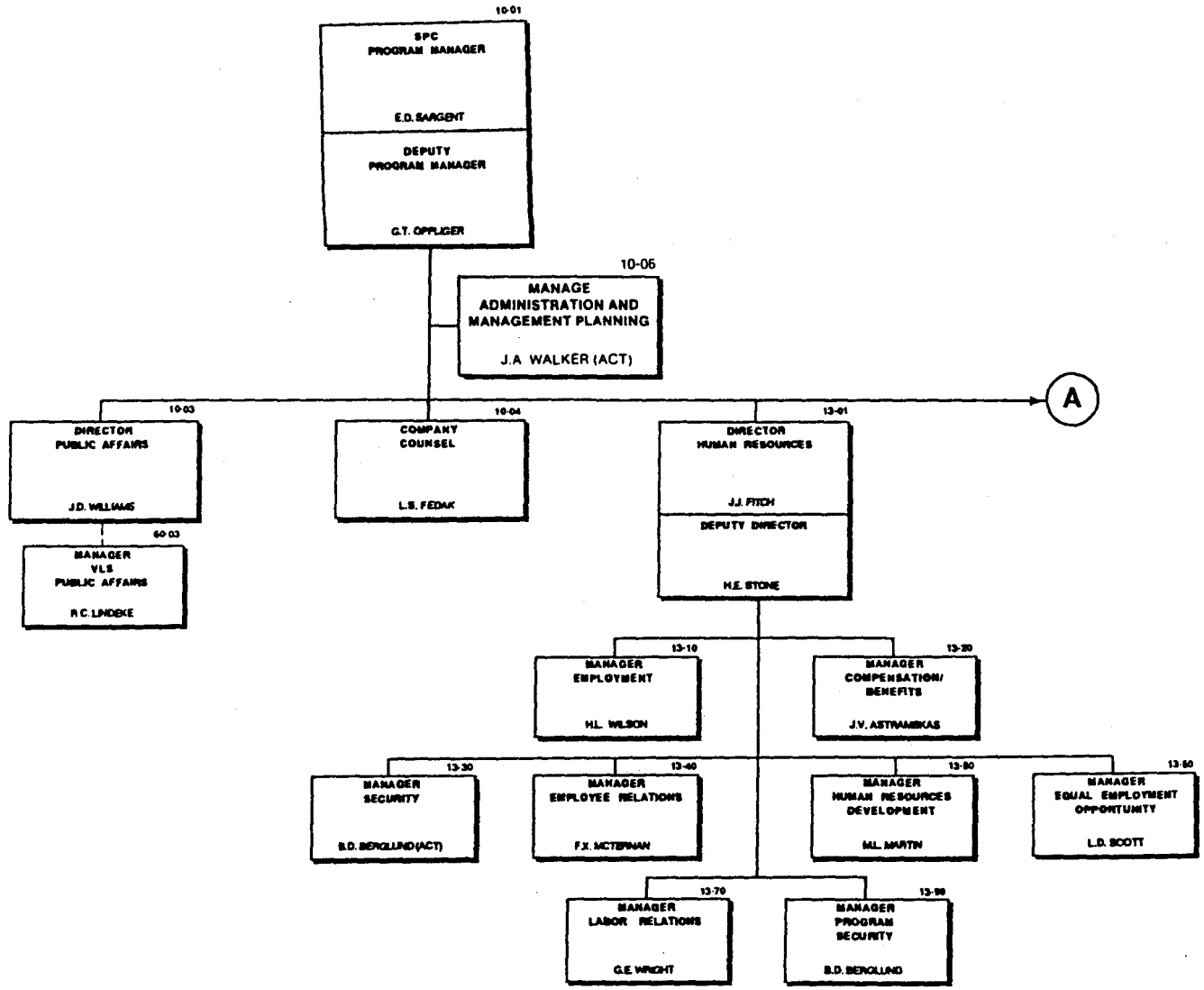

Figure 7-2.- Business Management organizational chart.

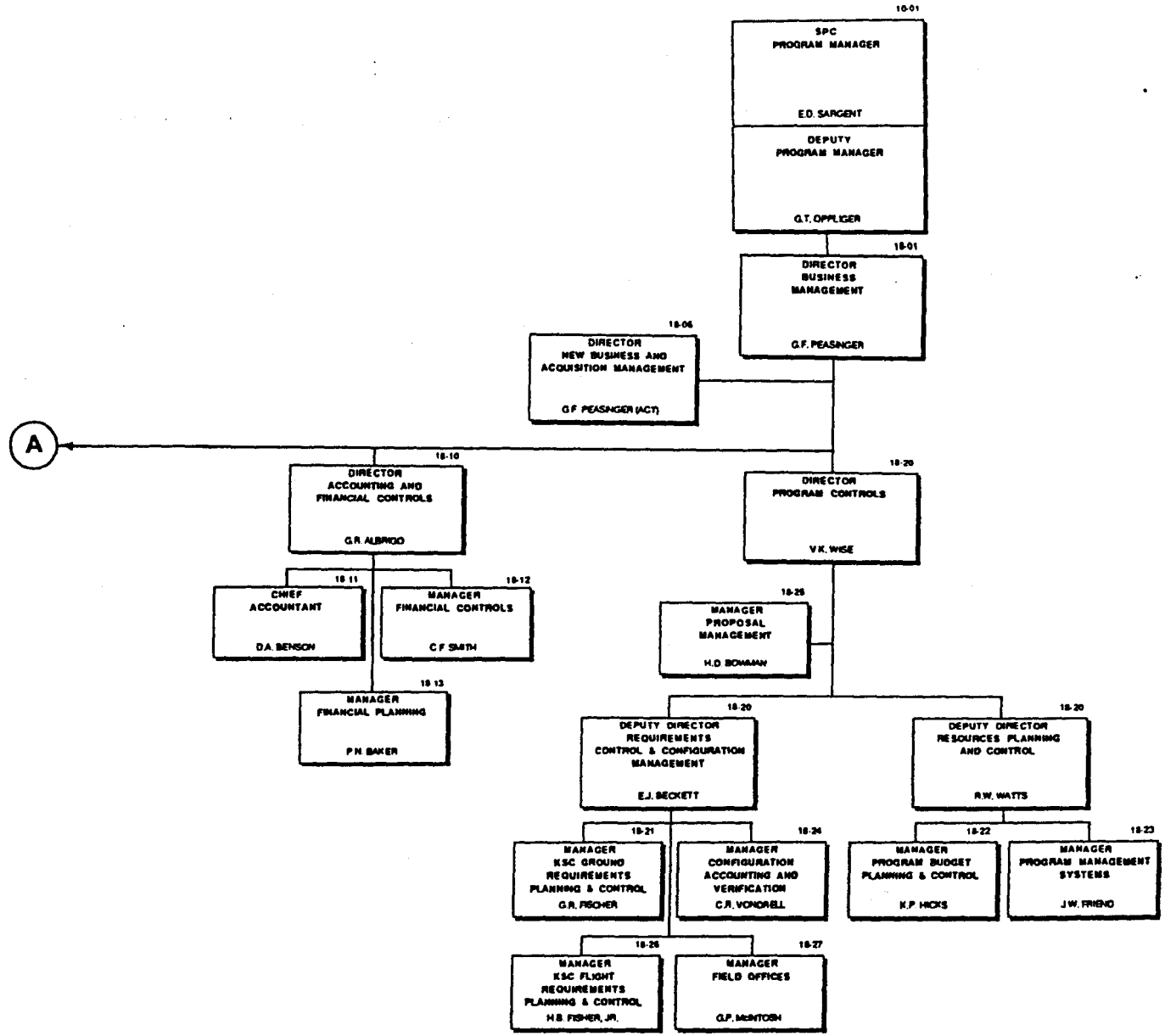

Figure 7-2.- Concluded.

TABLE 7-2.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
BUSINESS MANAGEMENT

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
XX-XX	BUSINESS MANAGEMENT		326	333	326	329	-1	-4
10-XX	PROGRAM MANAGER & STAFF	1.01	24	25	25	25	0	0
10-01	Program Manager		15	15	7	7	-8	-8
10-03	Public Affairs		5	5	5	5	0	0
10-04	Company Counsel		2	2	2	2	0	0
10-06	Admin & Mgt Planning		3	3	11	11	8	8
13-XX	HUMAN RESOURCES	1.017	70	71	70	71	0	0
13-01	Dir, Human Resources		8	8	11	11	3	3
13-10	Employment		9	9	8	8	-1	-1
13-20	Mgt Compensation		14	14	13	13	-1	-1
13-30	Security		19	19	19	19	0	0
13-40	Salaried Personnel		8	8	8	8	0	0
13-50	Human Resource Developmt		7	7	6	6	-1	-1
13-60	Equal Employm't Oppor'ty		3	3	3	3	0	0
13-70	Labor Relations		2	2	2	2	0	0
18-XX	BUSINESS MANAGEMENT	1.021	232	237	231	233	-1	-4
18-01	DIR, BUS. MGT/ Staff		16	16	3	3	-13	-13
18-06	NEW BUSINESS/ACQUISITION		1	1	1	1	0	0
18-1X	ACCTG & FINAN CONTROLS		47	48	46	46	-1	-2
18-2X	PROGRAM CONTROLS		93	95	131	132	38	37
18-3X	BUSINESS SYS & OFC SYS		68	69	44	44	-24	-25
18-40	CONTRACT ADMINISTRATION		7	7	6	6	-1	-1
18-1X	ACCTG & FINAN CONTROLS		47	48	46	46	-1	-2
18-10	Dir, Acctg & Finan Cntrls		4	4	4	4	0	0
18-11	Chief Accountant		30	31	28	28	-2	-2
18-12	Financial Controls		12	12	10	10	-2	-2
18-13	Financial Planning		1	1	4	4	3	3
18-2X	PROGRAM CONTROLS		93	95	131	132	37	36
18-20	Dir, Dep Dir (2) & Staff		5	5	13	13	8	8
18-22	Prog Budget Plng & Cntrl		21	21	14	14	-7	-7
18-23	Program Mgt Systems		17	17	15	15	-2	-2
18-25	Proposal Mgt		2	2	3	3	1	1
18-21	Grnd Rqrmts Plng & Cntrl		30	31	30	30	0	0
18-24	Config Acctg & Verif		0	0	31	31	31	31
18-26	Flt Rqrmts Plng & Cntrl		16	16	21	21	5	5
18-27	Field Office		3	3	4	4	1	1
18-3X	BUSINESS SYS & OFC SYS		68	69	44	44	-24	-25
18-30	LMIS Services		15	15	0	0	-15	-15
18-32	LMIS Busines Computer Op		9	9	9	9	0	0
18-34	LMIS Bus Sys Dev & Maints		18	18	17	17	-1	-1
18-35	KSC Office Systems & Svcs		26	27	18	18	-8	-8
18-4X	CONTRACT ADMINISTRATION		7	7	6	6	-1	-1

TABLE 7-3.- BUSINESS MANAGEMENT BREAKDOWN BY DEPARTMENT

DEPARTMENT: 10-01 NAME: SPC PROGRAM MANAGER

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROGRAM MANAGER	MANAGEMENT/DIRECT SPC
DEPUTY MANAGER	MANAGEMENT/DIRECT SPC
PRODUCTIVITY DIRECTOR	PRODUCTIVITY/MANAGE PRODUCTIVITY PROGRAM
TECHNICAL STAFF	TECHNICAL ASSISTANT/WORKS SPECIAL PROJECTS FOR PROGRAM MANAGER
CLERICAL	CLERK

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER OF FUNCTIONS TO 10-06

DELTA: -8

TABLE 7-3.- CONTINUED

DEPARTMENT: 10-03 NAME: DIR, PUBLIC AFFAIRS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT/PAO WORKING LEVEL DIRECTOR
EDITOR COMPANY PAPER	EDITOR
PUBLIC RELATIONS COORD.	PUBLIC RELATIONS ON THE SPC
CLERICAL	CLERK

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: NO CHANGE

TABLE 7-3.- CONTINUED

DEPARTMENT: 10-04

NAME: COMPANY COUNSEL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
LAWYER	LAW/SPC LEGAL SUPPORT
LEGAL ASSISTANT	LAW

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: NO CHANGE

TABLE 7-3.- CONTINUED

DEPARTMENT: 10-06

NAME: MGR, ADMIN & MGMT PLNG

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SUPERVISION	MANAGER
PREPARE SPIs	COORDINATOR FOR STANDARD PRACTICE INSTRUCTIONS (SPI) (APPROX. 400 RELEASED TO DATE)
DEVELOP MDs/MPs	COORDINATOR FOR MANAGEMENT DIRECTIVES (MDs) AND MANAGEMENT PROCEDURES (MPS) (APPROX. 161 MDs AND MPs RELEASED TO DATE)
MAINTAIN MANUAL DISTRIBUTION	CLERK
COMPUTER OPERATOR	WORD PROCESSING

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER OF FUNCTIONS TO 10-01

DELTA: +8

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-01 NAME: DIR, HUMAN RESOURCES

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
DEPUTY DIRECTOR	MANAGEMENT
SECRETARY	CLERICAL
H/R DATA BASE REP	H/R SPECIALIST
SPECIAL PROJECTS REP	H/R SPECIALIST
ADMIN PERSONNEL	ADMINISTRATIVE
SPECIAL SECURITY	DOD SECURITY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 INTERNAL TRANSFERS FROM 13-10, 13-20, 13-50

DELTA: +3

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-10 NAME: MGR, EMPLOYMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
RECRUITMENT	RECRUITER
PERSONNEL RELOCATION	RELOCATION OF PERSONNEL
ADMINISTRATIVE/CLERICAL	CLERICAL/ADMINISTRATIVE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO 13-01

DELTA: -1

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-20 NAME: MGR, COMPENSATION/BENEFITS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
BENEFITS ADMINISTRATOR	BENEFITS ADMINISTRATION
COMPENSATION ADMINISTRATOR	COMPENSATION
CLERICAL	CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO 13-01

DELTA: -1

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-30 NAME: MGR, SECURITY

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
SECRETARY	CLERICAL
INVESTIGATIVE REPRESENTATIVE	SECURITY
PERSONNEL SECURITY	SECURITY
INFORMATION SECURITY	SECURITY
COMMUNICATION SECURITY	SECURITY
PHYSICAL AND TECHNICAL SECURITY	TECHNICAL SECURITY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-40 NAME: MGR, SALARIED PERS RELATIONS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
EMPLOYEE RELATIONS	PERSONNEL SPECIALIST
EMPLOYEE SERVICES	EMPLOYEE SPECIALIST

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-50 NAME: MGR, HUMAN RES DEVELOPMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
MANAGEMENT TRAINING	TRAINING SPECIALIST
ADMINISTRATIVE/CLERICAL	ADMINISTRATIVE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO 13-01

DELTA: -1

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-60	NAME: MGR, EEO
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
REPRESENTATIVE	EQUAL EMPLOYMENT
CLERICAL	CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 13-70	NAME: MGR, LABOR RELATIONS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
LABOR RELATIONS REPRESENTATIVE	LABOR RELATIONS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-01

NAME: DIR, BUSINESS MANAGEMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
STAFF ASSISTANT	PROGRAM PLANNING
SECRETARY	CLERICAL/BUDGET

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

MOVED TO INDIRECT POOL

DELTA: -13

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-06

NAME: DIR, NEW BUSINESS & ACQUISITION MGT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-10 NAME: DIR, ACCTG & FINANCIAL CONTROLS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	ADMINISTRATIVE/FINANCIAL
ADMINISTRATIVE ASSOCIATE	ADMINISTRATIVE
STAFF SPECIALIST	ADMINISTRATIVE
INTERNAL ACCOUNTING CONTROLS	ADMINISTRATIVE/ACCOUNTING

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-11 NAME: CHIEF ACCOUNTANT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
CHIEF ACCOUNTANT	ADMINISTRATIVE/ACCOUNTING
SECRETARY	CLERICAL
ACCOUNTS PAYABLE	ACCOUNTING
PAYROLL	ACCOUNTING
FINANCIAL ACCOUNTING	ACCOUNTING/FINANCIAL/TAXES
CASH OPS/INVOICING	ACCOUNTING
CASHIER/TRAVEL ACCOUNTING	ACCOUNTING
TERMINAL OPERATORS	DATA ENTRY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -2

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-12

NAME: MGR, FINANCIAL CONTROLS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SUPERVISOR	ADMINISTRATIVE/FINANCIAL
SECRETARY	ADMINISTRATIVE
FINANCIAL ANALYSIS	FINANCIAL
PRICING	FINANCIAL
LABOR SURVEILLANCE	AUDIT

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -2

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-13

NAME: MGR, FINANCIAL PLANNING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SUPERVISOR	ADMINISTRATIVE/FINANCIAL
ANALYSTS	FINANCIAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +3

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-20 NAME: DIR, PROGRAM CONTROLS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
DEPUTY FOR BUDGET MANAGEMENT	MANAGEMENT
DEPUTY FOR CONFIGURATION MANAGEMENT	MANAGEMENT
SECRETARY	CLERICAL
PROGRAM INTEGRATION	SCHEDULERS & WORK FLOW COORDINATION
STAFF ASSISTANT	PROGRAM PLANNER
DATA MANAGEMENT SPECIALIST	DOCUMENT SPECIALIST
PROGRAM ASSESSMENT	AUDITOR/ASSESSOR

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER OF FUNCTIONS FROM 18-22

DELTA: +8

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-21 NAME: MGR, KSC GRND RQRMTS PLNG CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
SECRETARY	CLERICAL
DOD CERTIFICATION	CM ANALYST
REQUIREMENTS ANALYSIS	
SUPERVISOR	MANAGEMENT/ADMIN
LEVEL III CCB SUPPORT	CM ANALYST
TECHNICAL SUPPORT	ENGINEER
CHANGE MANAGEMENT & INTEGRATION SYSTEM	
SUPERVISOR	MANAGEMENT/ADMINISTRATOR
CHANGE MANAGEMENT	CM ANALYST & CLERICAL
INTEGRATED SUPPORT	CM ANALYST

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-22

NAME: MGR, PROGRAM BUDGET PLNG & CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
SUPERVISOR	SUPERVISOR
CLERICAL/ADMINISTRATION	ADMINISTRATIVE
BUDGET PLANNING	BUDGET ANALYST
OPERATIONS PLANNING & CONTROL & AUDIT	MANAGEMENT SYSTEMS ANALYST

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER OF FUNCTIONS FROM 18-20

DELTA: -7

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-23

NAME: MGR, PROGRAM MGMT SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
MANAGEMENT SYSTEMS & ANALYSIS	SUPERVISOR
RESOURCE INFORMATION AND SUPPORT	SUPERVISOR
ADMIN SUPPORT	SECRETARY
PROG/PROJ MEAS & ANALYSIS	MGMT SYSTEMS ANALYST
RESOURCE/PERFORMANCE SYSTEM	MGMT SYSTEMS ANALYST

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO 18-24 CONFIGURATION MANAGEMENT

DELTA: -2

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-24	NAME: CONFIG, ACCTG & VERIF.
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
PRODUCTION CONTROL	COMPUTER OPERATOR
OPERATIONS	COMPUTER OPERATORS
SYSTEM MAINTENANCE	PROGRAMMER/OPERATOR
ADMIN AND SUBCONTRACT MGMT	BUSINESS & SYSTEM ANALYSTS
ADMIN SERVICES	CLERICAL/ADMIN

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +31

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-25	NAME: MGR, PROPOSAL MGMT
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
PROGRAM PLANNING SPECIALIST	PROPOSAL COORD & DEVELOPMENT
SECRETARY	CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +1

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-26

NAME: MGR, KSC FLT RQRMTS PLNG & CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER	MANAGEMENT
SUPERVISORS	MANAGEMENT/ADMINISTRATIVE
SECRETARY	CLERICAL
VEHICLE REQUIREMENTS	ENGINEER SPECIALIST
LAUNCH OPERATIONS ORDER	ENGINEER SPECIALIST
CHANGE CONTROL GROUP	PROGRAM PLANNING ANALYST
MANIFEST PLANNING	ENGINEER SPECIALIST
ARTEMIS	OPERATIONS PLANNING ASSOCIATE
	SOFTWARE DATA PROCESSOR

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +5

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-27

NAME: MGR, FIELD OFFICES

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
JSC MANAGER	MANAGEMENT
SECRETARY	CLERICAL
MSFC MANAGER	MANAGEMENT
SECRETARY	CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +1

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-30, 32	NAME: MGR, LMIS BUSINESS COMPUTER OPNS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER/SUPERVISOR	TECHNICAL MANAGEMENT OF ADP SYSTEMS, HARDWARE, & FACILITIES
PRODUCTION CONTROL	COMPUTER OPERATOR
SYSTEM MAINTENANCE	COMPUTER OPERATOR/SYSTEM PROGRAMMER
OPERATIONS	COMPUTER OPERATOR

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO NEW DEPT. 18-24, CONFIG. ACCTG. & VERIF.

DELTA: -15

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-34	NAME: MGR, LMIS BUSINESS SYS DEV & MAINT
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER/SUPERVISOR	MANAGEMENT
SECRETARY	SECRETARIAL/ADMIN/DOC
PAYROLL/PERSONNEL	COMPUTER PROGRAMMER/ANALYST
FINANCIAL	COMPUTER PROGRAMMER/ANALYST
PERFORMANCE MEASUREMENT	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO NEW DEPT. 18-24, CONFIG. ACCTG. & VERIF.

DELTA: -1

TABLE 7-3.- CONTINUED

DEPARTMENT: 18-35 NAME: MGR, KSC OFFICE SYSTEMS & SERVICES

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SUPERVISOR	MANAGEMENT
SECRETARY	CLERICAL/ADMIN DUTIES
ADMIN & SUBCONTRACT MGMT	BUSINESS & CONTRACT MGMT/SYSTEMS & ANALYSIS
TECHNICAL SERVICES	DATA DEVELOPMENT/PROCESSING
ADMINISTRATIVE SERVICES	ADMIN & CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO NEW DEPT. 18-24 CONFIG. ACCTG. & VERIF.

DELTA: -8

TABLE 7-3.- CONCLUDED

DEPARTMENT: 18-40 NAME: DIR, CONTRACT ADMINISTRATION

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
CONTRACTOR ADMINISTRATOR	CONTRACTS LAW & ACCOUNTING
PROGRAM PLANNER	PLANNING & TRACKING
SECRETARY	CLERICAL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -1

7.3 II-XX SHUTTLE DATA SYSTEMS

The Shuttle Data Systems (SDS), shown in Figure 7-3, was formed after STS 51-L by transferring functions previously done in Process Engineering (LPS engineering) and in Business Management (Kennedy Data Management System (KDMS), now referred to as Shuttle Processing Data Management System (SPDMS)). SDS provides the technical engineering and manages the operations for the Shuttle Processing Data Management System. (Note that the Operations Control organization provides the test conductors who orchestrate the firing room operations and the backroom support, the Process Engineering organization mans the consoles in the firing rooms and Grumman operates and maintains the LPS hardware.)

The comparative pre-STS 51-L manpower levels for this organization was 460 E/P's (410 in headcount). In September 1987, the headcount is expected to be 372. A gradual increase throughout FY 1988, bringing the total to 415 by year end, is followed by further increases in FY 1989 to a level of 485. The justifications for the increase to 485 (490 E/P) are tied to the need to support new systems (e.g., Launch Team Training Simulation), new requirements in the LPS system software (FMEA's regression testing), closed loop OMRSD, and increased user support.

An SDS manpower bottoms-up analysis is shown in Table 7-4, and Table 7-5 details an SDS breakdown by department.

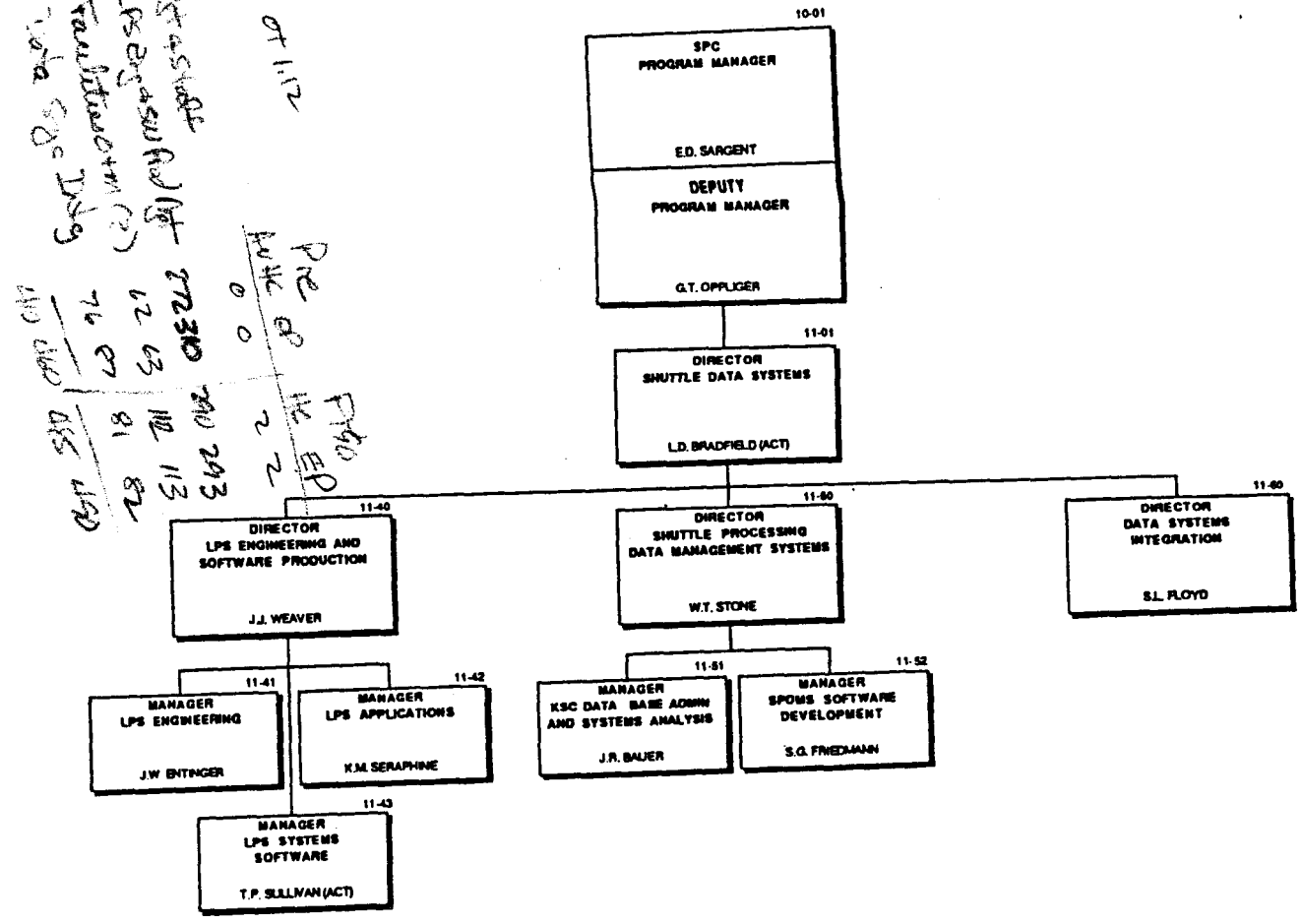

Figure 7-3.- Shuttle Data Systems organizational chart.

TABLE 7-5.- SHUTTLE DATA SYSTEMS BREAKDOWN BY DEPARTMENT

DEPARTMENT: 11-01

NAME: DIR, SHUTTLE DATA SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR, SHUTTLE DATA SYSTEMS	MANAGEMENT

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 2

TABLE 7-5.- CONTINUED

DEPARTMENT: 11-40, 11-41, 11-42, 11-43

NAME: DIR, LPS ENGRG S/W PRODN
MGR, LPS ENGINEERING
MGR, LPS APPLICATIONS
MGR, LPS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SUSTAINING ENGINEERING FOR LPS OPERATING SYSTEM SOFTWARE	MAINTAINS 1000K LINES OF CODE FOR CCMS AND 300K LINES OF CODE FOR FPS
SUSTAINING ENGINEERING FOR LPS HARDWARE	SUSTAINING ENGINEERING FOR APPROXIMATELY 300 MINICOMPUTER SYSTEMS
DEVELOPS AND MAINTAINS LPS APPLICATION	MAINTAINS 1700K LINES OF CODE FOR CDS AND 5200K LINES OF CODE FOR CCMS
MONTHLY CHANGE TRAFFIC	148 PRs, 284 GOAL UPDATES, 165 FSRs, 4 TCID BUILDS, 72,000 FUNCTIONS DESIGNATORS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

UPDATE AND MAINTAIN FMEAS (4 ENGINEERS)
PREPARE PROCEDURES RESULTING FROM OMRSD REQUIREMENTS (5 PERSONNEL)
REVIEW, VERIFY, DOCUMENT ALL ESA SOFTWARE (STS 51-L S/W REVIEW ITEM) (4 PERSONNEL)
CHANGE TRAFFIC INCREASING AS A RESULT OF STS 51-L SYSTEM REVIEWS (5 PERSONNEL)

DELTA: 18

TABLE 7-5.- CONTINUED

DEPARTMENT: 11-50, 11-51, 11-52	NAME: DIR, SHUTTLE PROC DATA MGMT SYS MGR, KSC DATA BASE ADMIN & SYS ANAL MGR, SPDMS SOFTWARE DEVELOPMENT
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE SOFTWARE DEVELOPMENT SUPPORT FOR PLANNING, CONTROLLING AND MANAGING GROUND OPERATIONS AND MAINTENANCE ACTIVITIES	MAINTAIN 1000K LINES OF CODE
PROVIDES SYSTEM ENGINEERING SUPPORT TO SPDMS USERS FOR REQUIREMENT DEFINITION AND VALIDATION AND PROVIDES TRAINING FOR SPDMS USERS	APPROXIMATELY 200 USERS PER MONTH BEING TRAINED IN PRACA AND AGOSS RESPOND TO 200 HELP CALLS/MONTH (1100 USERS ON SYSTEM)
CHANGE/MOD TRAFFIC/MONTH	5 LARGE ESRs
ACQUISITION PLANS, PROCUREMENT REQUESTS	1 MAJOR ACQUISITION PLAN, 70 PURCHASE REQUESTS/MONTH
DATABASE ADMINISTRATION AND SOFTWARE CONFIGURATION CONTROL	5 MAJOR RELEASES/MONTH 10 SUBRELEASES FOR PRs/MONTH

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- 0 ADDITIONAL INTERCENTER SUPPORT FOR ASRS, PRACA & OMRS CLOSED LOOP (+6 PERSONNEL)
- 0 REMOTE VLS SUPPORT DUE TO VLS COMPUTERS BEING MOVED TO KSC TO MEET PROCESSING DEMANDS (+2)
- 0 INCREASED DATA BASE ADMINISTRATION AND DATA DICTIONARY SUPPORT (+5 PERSONNEL)
- 0 IMPLEMENT INFORMATION CENTER, RESOURCE MGMT, ADP PLANNING, HELP DESK (+9)
- 0 INCREASE DEMAND FOR SPECIAL PROJECT SUPPORT (SPDM-II, AGOSS-II CONVERSION, PROCESS/CARGO/DESIGN ENGINEERING SUPPORT, LOGISTICS LASS, ETC.) (+10 PROGRAMMERS)

NEW REQUIREMENTS RESULTING FROM STS 51-L (CLOSED LOOP OMRSD)

- 0 INCREASED S/W DEVELOPMENT ENHANCEMENTS, CONVERSIONS, ESRs (+18 PROGRAMMERS)

DELTA: +50

TABLE 7-5.- CONCLUDED

DEPARTMENT: 11-60	NAME: MGR, DATA SYSTEMS INTEGRATION
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
RESPONSIBLE FOR GATHERING AND INTEGRATING USERS REQUIREMENTS	GENERATES AND MAINTAINS THE 1200 PAGE SPDMS REQUIREMENTS DOCUMENT
CONFIGURATION CONTROL FOR LPS AND SPDMS EMPLOYEE SERVICES	165 CCBDs, ESRs, EIs, OSCRs. TCTIs/MONTH, 23 BOARD MEETINGS/MONTH
RESOURCE MANAGEMENT OF LPS AND SPDMS COMPUTER RESOURCES	MANAGE 1100 USER IDs, WORK SPACE AND PERMISSIONS
SOFTWARE QUALITY ASSURANCE FOR LPS AND SPDMS	MAINTAIN 16 SPIs 140 PRs, 284 GOAL UPDATES
SECURITY	BADGING, SAFES
ESA AND FR2 OPERATIONS	228 DATA RETRIEVALS/MONTH

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASED SURVEILLANCE AND AUDIT OF LPS SOFTWARE FROM STS 51-L REVIEWS (OMRSD) (+2 PERSONS)
INCREASED RESPONSIBILITY FOR ALL S/W QA (+1 PERSON)
INCREASED USER SUPPORT (REQUIREMENTS, TRAINING, REPORT GENERATION & TROUBLESHOOTING) (+2 PERSON)

DELTA: +5

7.4 15-XX PAYLOAD INTEGRATION

Shuttle/Payload Integration's principal purpose is to perform launch site, on-line integration of STS payloads, experiments, and flight crew equipment into the Shuttle. A Shuttle Payload Integration organizational chart is included as Figure 7-4. O&M engineering for payload support ground systems (e.g., the Payload Ground Handling Mechanism, the Payload Changeout Room, and the Takeoff (T-0) electrical lines at the Mobile Launch Platform (MLP) and the pad for mission-unique payload requirements). Landing site support for payloads is also furnished by this organization. The manning levels prior to STS 51-L averaged about 117 equivalents. The projected levels for 1990 are estimated at 142 equivalents. (Both figures include 4 indirects). In September 1987, the headcount level is anticipated to be 103. A year later, the comparable figure grows to 123. Comparing the pre-STS 51-L and the September 1989 levels, the major increases in manning fall into departments 15-30, Shuttle/Payload Integration Engineering (+13 EP), and 15-40, Shuttle/Payload Project Management (+12 EP). Most of the workforce personnel are on the first shift (108 headcount), with 21 and 12 on the second and third shifts, respectively. Examples of second and third shift requirements are the installation of flight crew systems and equipment, optical alignments of Orbiter systems and the Space Shuttle Vehicle (SSV), and the payload-to-Orbiter interface testing. In December 1985, only one person was assigned to the third shift staffing, and overtime ran approximately 10 percent.

The rationales given for the increased staffing were: additional coordination requirements and more rigorous and improved test operations procedures; increased coverage for payload engineering support to processing operations, increased engineering certification and training requirements, and additional workload due to increased numbers of DOD missions. LSOC personnel noted that they had not made a specific provision for a higher level of optional services in FY 1990 than was experienced prior to 51-L.

A significant level of detail was furnished the team on manpower drivers, but a correlation of the manpower increases to the rationales given was not provided. Accordingly, while acknowledging the qualitative changes in the character of the work performed, there is yet some question as to whether these changes justify the need for the entirety of the 20 percent requested increase in manning.

A Shuttle/Payload Integration bottoms-up analysis is shown in Table 7-6. Table 7-7 shows a breakdown by department.

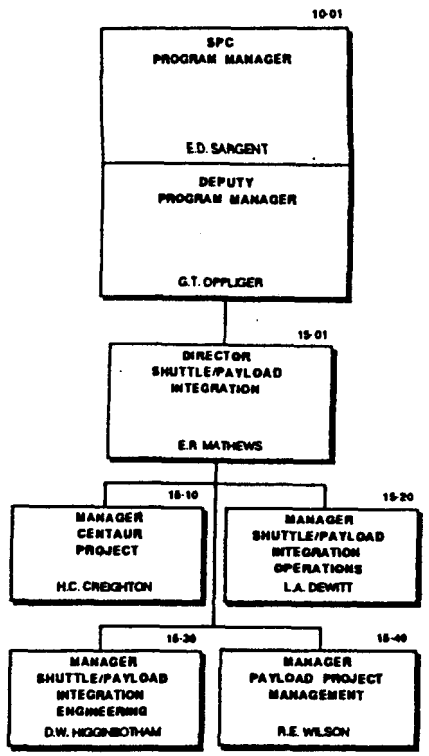

Figure 7-4.- Shuttle/Payload Integration organizational chart.

TABLE 7-6.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
SHUTTLE/PAYLOAD INTEGRATION

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
15-XX	SHUTTLE/PAYLOAD INT	1.10	107	117	141	142	34	25
15-01	DIR, SHUTTLE/PL INT	1.10	8	9	4	4	-4	-5
15-10	CENTAUR PROJECT	1.10	2	2	3	3	1	1
15-20	SHUTTLE/PL INT OPS	1.10	21	23	26	26	5	3
15-30	SHUTTLE/PL INT ENG	1.10	48	53	65	66	17	13
15-40	SHUTTLE/PL REQMTS & INT	1.10	28	31	43	43	15	13

TABLE 7-7.- SHUTTLE/PAYLOAD INTEGRATION
BREAKDOWN BY DEPARTMENT

DEPARTMENT: 15-01 NAME: DIR, SHUTTLE/PAYLOAD INTEGR

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER, STAFF	MANAGEMENT AND ADMINISTRATION

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER TO SUBORDINATE DEPARTMENTS

DELTA: -4

TABLE 7-7.- CONTINUED

DEPARTMENT: 15-10 NAME: MGR, PAYLOAD GROUND SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
COORDINATE/TRACK/MONITOR/DESIGN/IMPLEMENT MODIFICATION TO PAYLOAD RELATED FACILITIES AND GROUND SYSTEMS	24 PAYLOAD RELATED MODS MANDATORY FOR STS-26R WITH 36 ESRs 12 MODS/MISSION BY FY 90 AVERAGE OF 10/MISSIONS PRE 51-L

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASED EMPHASIS ON GSE SAFETY/RELIABILITY

DELTA: +1

TABLE 7-7.- CONTINUED

DEPARTMENT: 15-20

NAME: MGR, SHUTTLE/PAYLOAD INTEGRATION OPS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ON-LINE PAYLOAD OPERATIONS/INTEGRATION AND CONTROL: DEVELOP/COORDINATE SCHEDULES; DIRECT PAYLOAD, EXPERIMENT, OEX, FCE OPERATIONS - OPF - PAD	DRIVEN BY PROCESSING RATE/OPERATIONS GROUND RULES (5//3, 7/3 etc.) AND OVERTIME LIMITATIONS
OFF-SITE LANDING SUPPORT: RECOVERY OF PAYLOAD, FCE, AND EXPERIMENTS AT OTHER THAN KSC LANDING SITES	DRIVEN BY FLIGHT RATE. PERSONNEL ASSIGNED FROM WITHIN 15-20 ON COLLATERAL BASIS
MISSION EQUIPMENT SUPPORT/COORDINATE/DIRECT OFF-LINE PROCESSING OF PAYLOAD INTEGRATION HARDWARE, FCE, OEX; COORDINATE/DIRECT ON-LINE STORAGE AND DESTORAGE OF FCE/SUPPORT OFF-SITE FCE RECOVERY	DRIVEN BY LAUNCH RATE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 INCREASED COORDINATION AND REVIEW OF TOP'S, ABOUT 60 PER MISSION
0 OVERTIME RESTRICTIONS (2)
0 INCREASED VEHICLE TEST REQUIREMENTS DRIVES EXTENDED PRE-LAUNCH PROCESSING INTO MULTI-SHIFT OPERATIONS REQUIRING OPERATIONS ENGINEERING COVERAGE (2)
0 ALL LANDINGS OFF-SITE
0 INCREASED DOD MISSIONS FROM 2 TO 5 PER YEAR (1)

DELTA: +5

TABLE 7-7.- CONTINUED

DEPARTMENT: 15-30

NAME: MGR, SHUTTLE/PAYLOAD INTEGRATION ENGINEERING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PERFORM REQUIREMENTS ASSESSMENT, DEVELOP TOP'S CONDUCT PROCESSING AND TEST OPERATIONS FOR: - PAYLOAD INTEGRATION HARDWARE - PAYLOAD BAY RECONFIGURATIONS - ORBITER EXPERIMENTS - FLIGHT CREW EQUIPMENT - PAYLOAD/INSTALLATION/REMOVAL/HANDLING - INTERFACE TESTING	- REQUIREMENTS PER MISSION - 1000 - TOP PAGES PER MISSION - 4800 - PROBLEM PAGES PER MISSION - 250 - ON STATION TEST SUPPORT DEPENDS ON FLOW RATE AND OPERATIONS GROUND RULES
PERFORM OPTICAL ALIGNMENT FOR SHUTTLE ELEMENTS AND PAYLOADS	TOP PAGES PER FLOW - 45
OPERATIONS/MAINTENANCE ENGINEERING FOR PAYLOAD SUPPORT GROUND SYSTEMS	2 PADS/2 PGHMS/2 PCR'S/T-0 SYSTEMS - TOP PAGES - 35 PAGES - PROBLEM DISPOSITION - 400 PAGES - DATA COLLECTION - 500 PAGES

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASE IN DOD MISSIONS (1)
ADDITIONAL TRAINING AND CERTIFICATION REQUIREMENTS (5)
ADDITIONAL TOP COORDINATION/CLOSED LOOP REQUIREMENTS/SUSTAINED CIL/TOP DESIGN CENTER REVIEW (3)
INCREASED EMPHASIS ON GSE
INCREASED ENGINEERING FLOOR COVERAGE REQUIREMENTS AND ADDITIONAL TESTING/FLOW TIMES (3)
REDUCED OVERTIME (5)

DELTA: +17

TABLE 7-7.- CONCLUDED

DEPARTMENT: 15-40

NAME: MGR, SHUTTLE - PAYLOAD PROJECT MANAGEMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROJECT INTEGRATION: COORDINATE/OVERSEE PAYLOAD REQUIREMENTS INTEGRATION; LEAD LSOC PAYLOAD INTEGRATION TEAMS; COORDINATE PROCESSING - TEST REQUIREMENTS	DRIVEN BY RATE - INCLUDES MISSIONS IN PROCESS AND PLANNING FOR FUTURE MISSIONS
PROJECT ENGINEERING: TECHNICAL INTEGRATION OF MULTI-SYSTEM PAYLOAD REQUIREMENTS; REVIEW/ASSESSMENT OF REQUIREMENTS/ IMPLEMENTATION PLANS AND TOP'S; ON-LINE PAYLOAD TEST PROJECT ENGINEERING SUPPORT	DRIVEN BY RATE AND SUPPORT TO PAYLOAD INTEGRATION ENGINEERING. INCLUDES MISSIONS IN PROCESS AND PLANNING FOR FUTURE MISSIONS: DOCUMENTATION - TOP'S: 60 PER MISSION REQUIREMENTS: 5000 - 6000 PER MISSION
PROJECT PLANNING AND SUPPORT: PROCESS/ COORDINATE/CONTROL PAYLOAD MISSION CONFIGURATION, TEST, AND SUPPORT REQUIREMENTS; DEVELOP REQUIRED MISSION UNIQUE DOCUMENTATION	DRIVEN BY RATE, DOD DOCUMENTATION REQUIREMENTS, AND TOP COORDINATION
CONTAMINATION AND MATERIAL CONTROL: DEVELOP/MAINTAIN LSOC/SPC CONTAMINATION CONTROL PROGRAM FOR ORBITERS, PROCESSING FACILITIES AND PAYLOADS	RESPONSIBLE FOR FIVE IMPLEMENTATION PLANS; 20 TOPS; AVG PROBLEMS/MISSION - 40; STAFFING REQUIRES CORE PLUS PROCESSING MANPOWER

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASED DOD MISSIONS (2)
INCREASED TRAINING AND CERTIFICATION REQUIREMENTS (3)
SUSTAINING CIL/TOP REVIEW FOR MISSION UNIQUE TOPS (2)
INCREASED TOP REVIEW/COORDINATION/CLOSED LOOP REPORTING REQUIREMENTS (2)
EXTENDED FLOW TIME/INCREASED ENGINEERING COVERAGE REQUIREMENTS (3)
OVERTIME LIMITATIONS (3)

DELTA: +15

7.5 16-XX OPERATIONS CONTROL

The Operations Control organization, shown in Figure 7-5, was created to augment the planning, the scheduling, the analysis, and the conduct of operations. The Launch Control Complex operation provides the flow controllers and firing room test conductors, does OMI development, and has firing-room personnel training responsibility. This accounts for about 109 equivalents in FY 1990, an increase from 76 prior to STS 51-L. The key reasons for the increase were the new emphasis on training, including the implementation of the Launch Team Training System and the addition of site test conductors in the VAB.

Other than a small group of 15 Pan Am personnel doing operations analyses and the new 6 man operations control management staff, the Process Planning and Control (PP&C) department accounts for the remainder of the 464 E/P's planned for FY 1990. Prior to STS 51-L, the PP&C organization was staffed at an average level of 261 and worked about 13 percent overtime, for a total of 295 E/P's. Current planning calls for this group to increase in equivalents to the 333 level. Since this group does the integrated work control, planning, scheduling, and status reporting for the processing operations on a real-time basis, an element of this increase was justified by there being not only more processing work and formal reviews to support but also a realized need to improve the quality and timelines of status reporting, documentation control, and schedules.

An Operations Control bottoms-up analysis is shown in Table 7-8, followed by Table 7-9, a breakdown by department.

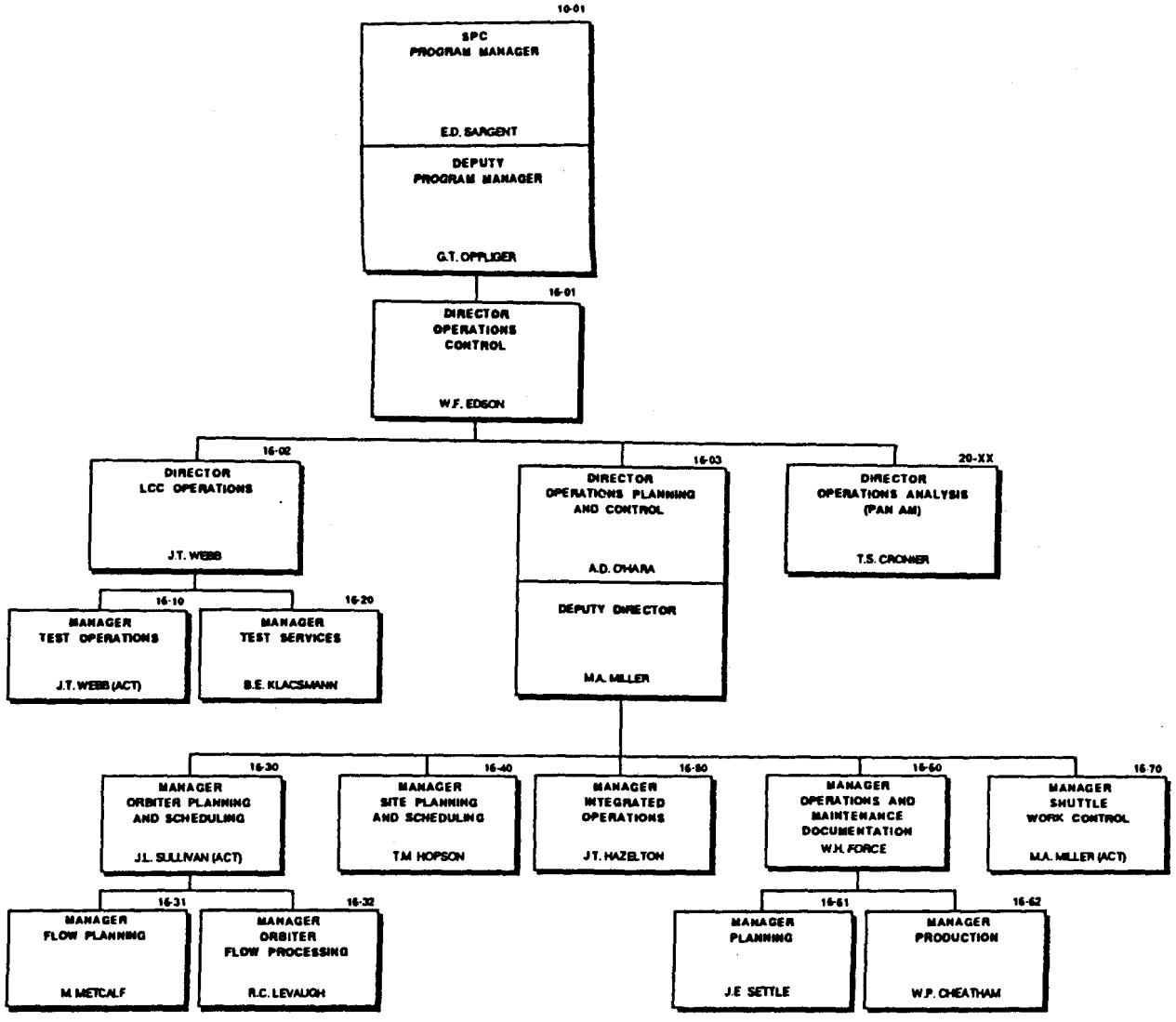

Figure 7-5.- Operations Control organizational chart.

TABLE 7-8.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
OPERATIONS CONTROL

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
16-XX	OPERATIONS CONTROL	1.13	345	389	459	464	114	75
16-01	OPERATION CONTROL STAFF		0	0	6	6	6	6
16-02	LCC OPERATIONS	1.11	68	76	108	109	40	33
16-02	Staff		3	3	3	3	0	0
16-10	Test Operations		48	54	81	82	33	28
16-20	Test Services		17	19	24	24	7	5
16-03	PROCESS PLANNING & CTL	1.13	261	295	330	333	69	38
16-03	Staff		5	6	5	5	0	-1
16-30	Plans & Scheduling		20	23	4	4	-16	-19
16-31	Multi-Flow Planning/GSE		18	20	21	21	3	1
16-32	Flow Processing		12	14	45	45	33	32
16-40	Integrated Work Control		73	82	87	88	14	5
16-50	Integrated Process Ctl		20	23	21	21	1	-1
16-60	Process Planning Staff		3	3	4	4	1	1
16-61	Planning Control & Reqts		17	19	34	34	17	15
16-62	Production & Release		33	37	50	51	17	13
16-70	Work Control		60	68	59	60	-1	-8
20-XX	PAA/OPERATIONS ANALYSIS	1.13	16	18	15	15	-1	-3

TABLE 7-9.- OPERATIONS CONTROL BREAKDOWN BY DEPARTMENT

DEPARTMENT: 16-01	NAME: OPERATIONS CONTROL
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGE, DIRECT, INTEGRATE ALL OPERATIONAL ISSUES WITHIN SPC
SECRETARIAL STAFF	
ADMINISTRATIVE STAFF	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DIRECTORATE ESTABLISHED TO ENHANCE INTEGRATION OF SPC PLANNING AND SCHEDULING FUNCTIONS

- o ANOTHER LAYER OF MANAGEMENT IS REQUIRED DUE TO THE DIFFICULTY OF INTEGRATING OPERATIONS IN THE FIRING ROOM AND ON THE FLOOR OPERATIONS AT THE VAB/OPF/PAD FACILITIES
- o LCC COORDINATION WITH OTHER ELEMENTS WAS NOT BEING PERFORMED EFFECTIVELY & EFFICIENTLY PRE-51-L

DELTA: +6

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-02	NAME: DIRECTOR, LCC OPERATIONS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
SECRETARY	CLERICAL
TECHNICAL STAFF	TECHNICAL ASSISTANCE PROVIDED TO CONDUCT SPECIAL STUDIES AND PREPARE MANAGEMENT REPORTS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-03

NAME: DIR, PROCESS PLANNING & CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	MANAGEMENT
DEPUTY	MANAGEMENT
SECRETARY	CLERICAL
TECHNICAL STAFF	TECHNICAL ASSISTANCE PROVIDED TO CONDUCT SPECIAL STUDIES (e.g., AUTOMATION STUDIES, SPDMS, WORK CONTROL)

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-10, 16-20

NAME: MGR, TEST OPERATIONS
MGR, TEST SERVICES

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
TEST OPERATIONS	TEST DIRECTORS SUPPORT ALL LC-39 OPERATIONS
TEST DIRECTORS	SINGLE POINT OF CONTACT BETWEEN TEST TEAM
ORBITER TEST CONDUCTOR	
TANK/BOOSTER TEST CONDUCTOR	
CARGO/OMI INTEGRATION	
FLOW/SITE OPERATIONS	MONITORS CERTIFICATION OF ALL FIRING ROOM
TEST TEAM TRAINING	TEST TEAM PERSONNEL
	APPROVES ALL OMI ICRS (30)
TEST SERVICES	
COMPUTER SUPPORT	STAFF THE SPC/NASA REALTIME
VITT SUPPORT	SCHEDULE AND EMERGENCY INFORMATION
OPS CENTER SUPPORT	DISTRIBUTION CENTER
	REVIEWS, APPROVES, AND TRACKS ALL LCC FACILITY MODIFICATIONS
	DOCUMENTS MAJOR MILESTONE REVIEWS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

16-10
- 0 ASSUMED NEW VAB PAD LEADER FUNCTION (9)
- 0 FULL UP CONSOLE MANNING RATHER THAN MULTIPLE STATION COVERAGE BY ONE OPERATOR TO INSURE ALL SYSTEMS MONITORING EXPERTISE (9)
- 0 STAFFING FOR NEW LAUNCH TEAM TRAINING AND CERTIFICATION PROGRAM (9)
- 0 OVERTIME REDUCTION AND NEW OVERTIME REGULATIONS LIMITING HOURS AND CONSECUTIVE WORK DAYS (6)

16-20
- 0 OVERTIME REDUCTION AND NEW OVERTIME REGULATIONS LIMITING HOURS AND CONSECUTIVE WORK DAYS (2)
- 0 PROGRAM REQUIREMENTS FOR ADDITIONAL COMPUTER PRODUCTS TO SUPPORT LRR, PIPELINE, SOWG, ETC. (5)

DELTA: +40

TABLE 7-9- CONTINUED

DEPARTMENT: 16-30, 31, 32

NAME: MGR, PLANS & SCHEDULING
MGR, MULT-FLOW PLNG/SCHED/
MGR, FLOW PROCESSING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DEVELOP/STATUS ORBITER MODIFICATIONS SCHEDULES	SOME TASKS ARE FIRST SHIFT OPERATIONS AND ARE DRIVEN BY VEHICLE MODIFICATIONS AND CHANGES
PROVIDE OPF/HMF/OMRF OPEN ITEM STATUS	
DEVELOP ORBITER STRUCTURAL INSPECTION SCHEDULES	SOME TASKS IN DIRECT SUPPORT OF VEHICLE TESTING DO REQUIRE SECOND/THIRD SHIFT OPERATION
DEVELOP MULTI-VEHICLE AND HARDWARE UTILIZATION SCHEDULES	
DEVELOP NEAR TERM MANIFEST ASSESSMENTS CONDUCT OPEN ITEM AND CONSTRAINTS REVIEWS AND MAINTAIN CONSTRAINTS LIST	NUMBERS DRIVEN BY # OF ORBITERS IN OPF/OMRF AND AMOUNT OF HARDWARE IN HMF AND NUMBER OF SHIFTS OF PROCESSING ON EACH VEHICLE
GSE/VEHICLE SCHEDULING COORDINATION ASSURE SCHEDULE TASK READINESS	
SCHEDULING AT HMF FOR PODs/FRCS/TPS	
DEVELOP, MAINTAIN AND STATUS TASK MINI SCHEDULES	
CONDUCT SCHEDULING AND STATUS/PROBLEM IDENTIFICATION AND RESOLUTION MEETINGS	
COORDINATE OUTSIDE SCHEDULE SUPPORT	
DEVELOP, MAINTAIN AND STATUS KICS AND FLOOR SCHEDULE	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 GSE WORK CONTROL TRANSFERRED TO 16-40	DELTA: +20
0 EXPECTED INCREASE IN PROGRESSIVE REQUIREMENTS ON ALL SHIFTS	

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-40

NAME: MGR, INTEGRATED WORK CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
COORDINATE OUTSIDE SCHEDULE SUPPORT	
SITE MODIFICATION SCHEDULING/STATUS	
ASSURE SCHEDULE TASK READINESS	
MAINTAIN/UTILIZE OPEN ITEM STATUS REPORT	
GSE SCHEDULING	
GSE AND FACILITY OPEN ITEMS STATUS FOR OISR	
CONDUCT OPEN ITEMS AND CONSTRAINT REVIEWS AND MAINTAIN CONSTRAINTS LIST	
COORDINATE SUPPORT/INTEGRATE SCHEDULING ACTIVITIES	DRIVEN BY NUMBER OF LOCATIONS TO BE COVERED AND SHIFTS COVERAGE AT THOSE LOCATIONS
DEVELOP AND STATUS ET/SRB MOD SCHEDULES	ALSO DRIVEN BY NUMBER OF GSE END ITEMS AND VOLUME OF WORK ON THESE
DEVELOP AND MAINTAIN DETAILED WORK SCHEDULES	
DEVELOP, MAINTAIN, AND STATUS MINI SCHEDULES	
CHAIR SCHEDULING MEETINGS AND STATUS/PROBLEM IDENTIFICATION MEETINGS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

GSE WORK CONTROL TRANSFERRED IN FROM 16-30/31/32	DELTA: +14

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-50

NAME: MGR, INTEGRATED PROCESSING CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PREPARATION, PUBLICATION AND DISTRIBUTION OF THE KSC INTEGRATED CONTROL SCHEDULE (KICS)	DRIVEN BY THIS NUMBER OF SCHEDULES TO MAINTAIN, THE NUMBER OF AS-RUNS TO BE DEVELOPED AND THE NUMBER OF SPECIAL STUDIES
RESOLUTION OF SCHEDULE AND SUPPORT CONFLICT; BETWEEN SPC SITES, BETWEEN SPC AND OTHER CONTRACTORS, AND BETWEEN SPC ELEMENTS	PERSONNEL ON FIRST SHIFT EXCEPT DURING CRITICAL PAD PRELAUNCH OPERATIONS
DEVELOPMENT OF IMPACT ASSESSMENTS AND/OR RECOVERY SCHEDULES WHEN PROBLEMS ARISE OR WHEN MANIFEST CHANGES ARE PROPOSED	
PREPARATION, PUBLICATION AND DISTRIBUTION OF THE AS-RUN SCHEDULES FOR SHUTTLE FLOWS	
PREPARATION AND PUBLICATION OF SPECIAL SCHEDULES AS REQUIRED BY SPC AND NASA MANAGEMENT.	
CHAIR INTEGRATED SCHEDULE AND STATUS MEETINGS.	
PROVIDE MANAGEMENT WITH INTEGRATED STATUS.	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +1

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-60

NAME: MGR, PROCESS PLANNING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
RESPONSIBLE FOR OVERALL MANAGEMENT OF FUNCTIONS PERFORMED BY DEPARTMENT	FUNCTIONS PERFORMED BY ONE MANAGER, TWO SECRETARIES AND ONE ILLUSTRATOR, ON FIRST SHIFT ONLY
PROVIDE ILLUSTRATION SUPPORT FOR PP&C	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +1

THIS NUMBER IS FOR DEPARTMENT, NOT STAFF

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-61	NAME: MGR, PLANNING CONTROL & REQUIREMENTS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROCESS REQUIREMENTS CHANGE NOTICES (RCNs) AND WAIVERS/EXCEPTIONS TO OPERATIONS AND MAINTENANCE REQUIREMENTS AND SPECIFICATIONS (OMRS)	MANPOWER DRIVEN BY LAUNCH RATE
MAINTAIN OMRS OPERATIONS AND MAINTENANCE PLAN (OMP) DATA BASE	
DEVELOP, MAINTAIN AND DISTRIBUTE PROCESSING SUPPORT PLAN (PSP)	
MAINTAIN STANDARD TASK FILE (STF) COMPRISED OF ALL SHUTTLE PROCESS TASKS	IS ALSO DRIVEN BY NUMBER OF CHANGES REQUIRED FOR A SPECIFIC FLOW
PROVIDE OMP FOR EACH MISSION AND PROVIDE VERIFICATION OF OMRS ACCOMPLISHMENT	
STATUS PROCESS PLANNING OMD DEVELOPMENT/ RELEASE	
OPERATE COMPUTERS/PRINTERS THAT SUPPORT OMD PRODUCTION	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 EXPECTED INCREASE IN CHANGE CONTROL WORKLOAD

DELTA: +17

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-62	NAME: MGR, PRODUCTION RELEASE
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DEVELOP, MAINTAIN AND DISTRIBUTE OPERATIONS AND MAINTENANCE DOCUMENTATION INCLUDING OMIs, OMs, ICRs, AND JOB CARDS AND PROCESS OMI SUMMARY SHEETS	MANPOWER IS DRIVEN BY LAUNCH RATE, BY RATE, BY PAYLOAD, BY NUMBER OF CHANGES PER FLOW, AND BY REAL-TIME CHANGES.
ISSUE OMI, TEST PREPARATION SHEET (TPS) AND SUPPORT EQUIPMENT MOVE AUTHORIZATION (SEMA) NUMBERS	SOME IS DRIVEN BY QUANTITY OF GSE AND HARDWARE AT KSC.
PREPARE TECHNICAL OPERATING PROCEDURES (TOPs) AND ASSOCIATED HANDBOOKS	
ASSEMBLE, RELEASE, AND TRACK TEST AND INSPECTION RECORD (TAIR) BOOKS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 EXPECTED INCREASE IN REAL TIME WORK

DELTA: +17

TABLE 7-9.- CONTINUED

DEPARTMENT: 16-70

NAME: MGR, WORK CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
RELEASES ALL PAPER TO THE QUALITY TAIR STATIONS MANAGES THE RMRS SYSTEM SERVES AS THE DATA MANAGER FOR ALL AUTOGOSS USERS RESPONSIBLE FOR UPDATING THE OISR BASED UPON INPUTS AND REDLINES FROM THE VEHICLE AND GSE PLANNING AND SCHEDULING ORGANIZATIONS	MANPOWER DRIVEN BY: AMOUNT OF GSE AT KSC VOLUME OF WORK - # OF VEHICLES IN FLOW AND LAUNCH RATE SHIFT COVERAGE REQUIRED TO SUPPORT PROCESSING

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -1

TABLE 7-9.- CONCLUDED

DEPARTMENT: 20-XX

NAME: DIR, OPERATIONS ANALYSIS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DEVELOP & FACILITATE IMPROVEMENTS IN SPC PLANNING, SCHEDULING, AND WORK CONTROL SYSTEM ANALYZE GSE MAINTENANCE & OPERATIONAL REQUIREMENTS TO ENHANCE SPC UTILIZATION PROVIDE OPERATIONS ANALYSIS SUPPORT TO INTEGRATE ORGANIZATIONS/FUNCTIONS TO ENHANCE QUALITY ANALYZE PROCESSING FLOWS TO DETERMINE CRITICAL PATH & KEY PROCESSING FACTORS PROVIDE TECHNICAL SUPPORT TO IMPLEMENT OMRSD V30, V31, AND V32 FILE REQUIREMENTS PROVIDE SRM & QA THROUGH FUNCTIONAL ANALYSIS AND OPERATIONAL IMPROVEMENTS	MANPOWER DRIVEN BY NEED TO WORK WITH MULTIPLE PP & C FUNCTIONS TO IDENTIFY REQUIREMENTS & RECOMMEND ENHANCEMENTS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

LESS APPLICABILITY OF AIRLINE OPERATIONS IN NEW LAUNCH ENVIRONMENT

DELTA: -1

7.6 17-XX SHUTTLE AND GROUND SUPPORT ENGINEERING

Shuttle and Ground Support Engineering organization is depicted in Figure 7-6. A manpower bottoms-up analysis of total engineering is shown in Table 7-10, and Table 7-11 breaks down engineering by department. For discussion purposes, Sustaining Engineering refers to the Ground Systems Design Engineering organization, and Process Engineering refers to all other organizations and personnel in Shuttle and Ground Support Engineering.

7.6.1 Process Engineering

Process Engineering (PE) provides direct engineering support for all processing activities. PE personnel support the geographically dispersed processing facilities (e.g., the OPF, the Horizontal Mating Facility (HMF), the VAB, the pads, Hangar AF, the LCC, and primary and contingency landing sites). Prior to STS 51-L, the overtime required for the 211 electrical/mechanical systems and the 214 fluid/mechanical systems engineers supporting the OPF activities averaged between 12 percent and 23 percent across the six departments, with a maximum weekly peak of 31 percent. The organization's monthly work volume indicators for the fourth quarter of calendar year 1985 show than an average of 3,429 unplanned, real-time work authorization documents required PE preparation, disposition, and closure, excluding tile work which required another 2,500 documents. Resolutions of inflight anomalies average 30 per month, and change assessments to the configuration and/or requirements amounted to 258 change packages per month. The LSOC representative indicated that the unplanned work consumed a large amount of manpower.

As noted previously, one of the major program changes resulting from the post-Challenger reviews was to increase the level of engineering involvement in all operational aspects. Having process engineers on the OPF floor to cover 7/3's represents a significant change. LCC console manning guidelines have been changed to assure a prime and a backup engineer both being on station. Test requirements have increased. The change system has become considerably more rigorous, particularly for GSE, with greater interface requirements with the design centers. In addition, the renewed emphasis on training has been estimated to consume between 5 percent and 8 percent of an engineer's time.

The team was furnished the LSOC analysis of the October-December 1985 workload vs. manpower experience which indicates that approximately 87 of the 587 average equivalents should be discounted for such items as Centaur modifications, Pad-B validations, and Vandenberg Launch and Landing Site (VLS) support. The net 500 equivalents compare to the 850 equivalents (842 headcount) planned to be reached by July 1989. (At the end of FY 87, 662 headcount; at the end of FY 88, 720 headcount.) This increase is broken down as follows: (1) About 62 employees of this increase, from a level of 318 EP's to 390, will be for direct support to vehicle processing. (2) Vehicle mods support accounts for 20 (was 23, planned 43); this increase was justified on the basis that the reference period was one during which opportunity mods were being accumulated because there wasn't time to

implement them. (LSOC believes that a change in the program approach to carry out opportunity mods in a block mod period, probably coincident with structural inspections, would be a more efficient use of manpower.) (3) As previously indicated, there is now a specific provision for training overhead impacts on staffing; this accounts for the increase from a level of 4 E/P's at present to 66 E/P's in FY 1990. (4) In the area of engineering support for GSE maintenance, the manpower estimates indicate an increase of 52, from 73 to 125. This delta was explained as being tied to a major change in attitude toward the criticality of GSE. For example, LSOC plans on having the preventative maintenance OMI's on GSE reworked and increasing the level of routine maintenance instead of deferring this work as was the case prior to STS 51-L. The revised manpower estimates also allow for the increased GSE change interface requirements with Level II and the need for taking waivers to local change boards versus having the responsible engineer disposition the waiver. (5) Provision for GSE modifications support showed an increase of 29 (was 6, new plan 35); the reference period, however, had about 30 engineers working on the activation of pad-B and MLP-3 and a large backlog of modifications on GSE designed by Rockwell and GSE designed by KSC/Design Engineering was being allowed to accumulate. (6) The remainder of the total increase, about 90, from 95 in the pre-STS 51-L period to 185 in FY 1990, was justified in having a new computer system required support (+7), in providing for ongoing enhancements (e.g., the new tile engineering tracking system) and in generating OMI's for Line Replaceable Unit (LRU) and LRU testing, and on the increase in management and staff associated with strengthening management oversight and managing the larger PE workforce.

7.6.2 Ground Systems Design Engineering (Sustaining Engineering)

Sustaining engineering provides the design engineering support for KSC ground systems. This includes planning, requirements analysis, design, budget formulation, scheduling, and execution of engineering for all assigned KSC-provisioned Shuttle ground facilities, systems and equipment. The actual work is carried out by the Support Operations organization, either with LSOC technicians or by subcontracting the work.

Prior to STS 51-L, KSC's Design Engineering Directorate had employed PRC and other contractors to execute facility and equipment new designs and modifications. This has now been made an SPC responsibility. This transfer accounts for almost 100 workers in the growth of manning levels from a pre-STS 51-L average of 135 (86 Shuttle operations DEQ's) to a current level of 350. The current level is projected to remain nearly constant throughout FY 1988-1989, with the Shuttle Operations DEQ's at 324 in FY 1990. These projections assume, however, that no new facility or major modifications are authorized.

At present, much of the SPC sustaining engineering workforce is occupied in carrying out the return to flight status (RTFS) modifications. The backlog of category 2 modifications is increasing, due to the RTFS work, from 527 outstanding engineering support requests (ESR's) in January 1986 to a current backlog of 1,050 ESR's. LSOC estimates that an average ESR requires 100 hours of design time and 40 hours to assess. With a design engineering

group of approximately 225 persons and an assessment group of about 120 persons, it is clear that the current (and projected) manning levels will not allow the existing backlog of ESR's to be worked off. Discussions with LSOC personnel also indicate that the lack of automated tools, such as Computer Aided Design/Computer Aided Engineering (CAD/CAE), make this a more manpower-intensive operation than it could be.

In addition, discussions with KSC and SPC personnel indicate that the deficiency pointed out in the post-STS 51-L reviews of having facility design drawings with up to 100 Engineering Orders (ED's) (8 to 10 EO's is considered reasonable) will not be workable until after Shuttle flights resume in June 1988. When asked why the present manpower level is considered acceptable, KSC and SPC personnel revealed that a manning level of almost 500 had been requested by cognizant personnel. This higher level was rejected due to affordability concerns. (Note that if more ESR's were processed, there would be a concommitant increase in either SPC Support Operations manpower or subcontract costs, plus material costs, to implement the changes.)

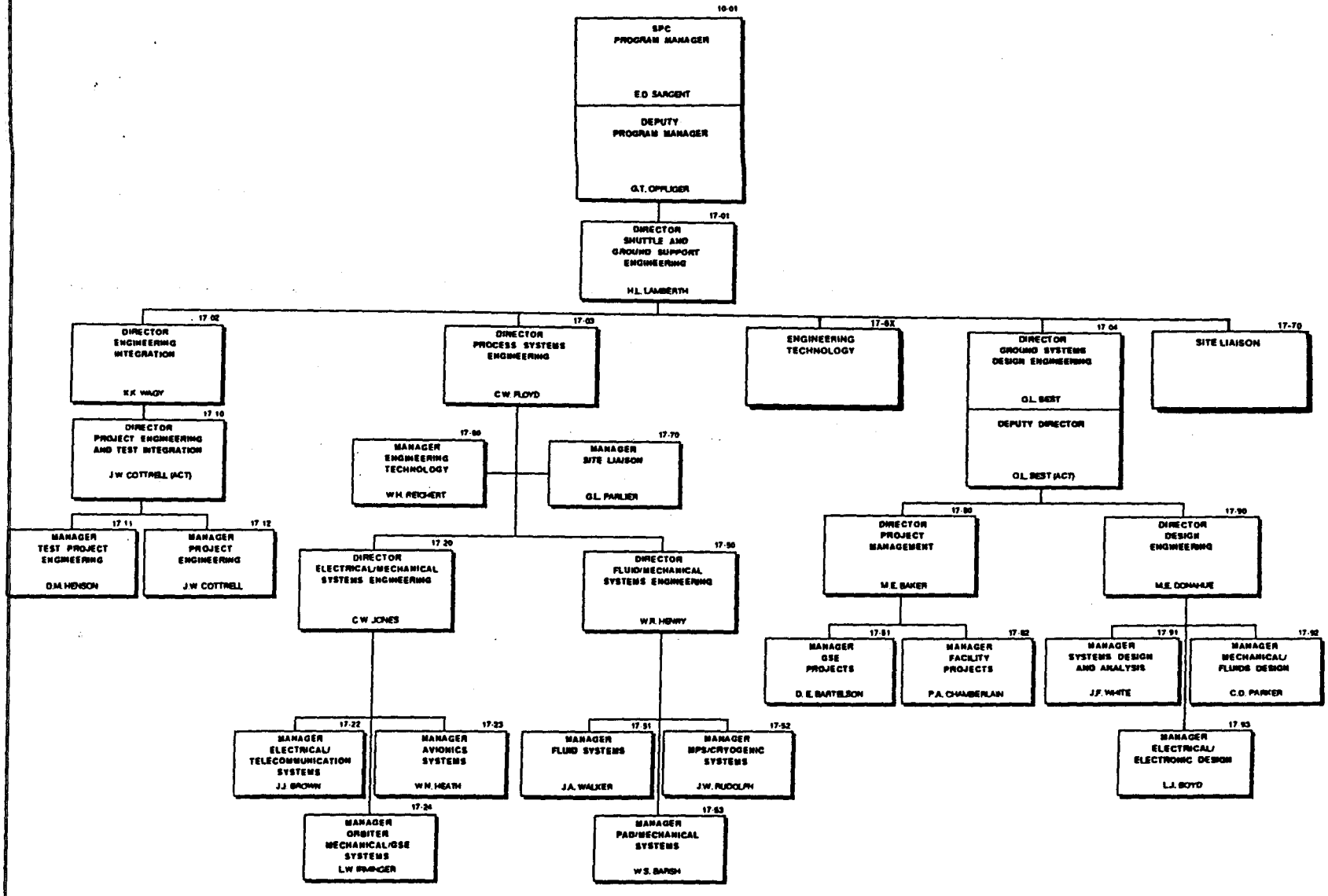

Figure 7-6.- Shuttle and Ground Support Engineering organizational chart.

TABLE 7-10.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
SHUTTLE & GROUND SUPPORT ENGINEERING

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
17-XX	TOTAL ENGINEERING	1.12	647	725	1166	1178	519	452
17-0X	MANAGEMENT & STAFF	1.04	23	24	29	29	6	5
17-01	MANAGEMENT & STAFF	1.04	15	16	13	13	-2	-3
17-02	ENGINEERING INTEGRATION		0	0	2	2	2	2
17-03	PROCESS SYSTEMS ENGRG		0	0	2	2	2	2
17-04	GROUND SYS DESIGN ENGRG		8	8	12	12	4	4
17-1X	PROJ ENGRG & TEST INT	1.17	52	61	90	91	38	30
17-10	PROJ ENGRG & TEST INT	1.17	52	61	2	2	-50	-59
17-11	TEST PROJECT ENGINEERING		0	0	29	29	29	29
17-12	PROJECT ENGINEERING		0	0	59	60	59	60
17-2X	ELECT/MECHANICAL SYS ENG	1.15	237	271	371	375	134	104
17-20	ELECT/MECHANICAL SYS ENG	1.02	20	20	2	2	-18	-18
17-22	Elect/Telecomm Sys	1.12	95	106	149	150	54	44
17-23	Avionics Sys	1.14	58	66	93	94	35	28
17-24	Orbiter Mech/GSE Sys	1.23	64	79	127	128	63	49
17-5X	FLUID/MECHANICAL SYS ENG	1.14	194	221	331	334	137	113
17-50	FLUID/MECHANICAL SYS ENG		2	2	2	2	0	0
17-51	Fluid Sys		78	89	127	128	49	39
17-52	MPS/Cryo Sys		72	82	117	118	45	36
17-53	Pad/Mechanical Sys		42	48	85	86	43	38
17-6X	ENGINEERING TECHNOLOGY	1.00	5	5	6	6	1	1
17-70	SITE LIAISON	1.11	9	10	27	27	18	17
17-8X	PROJECT MANAGEMENT	1.04	46	49	115	116	69	67
17-80	Project Integration		3	4	24	24	21	20
17-81	GSE Projects		26	27	46	46	20	19
17-82	Facility Projects		17	18	45	45	28	27
17-9X	DESIGN ENGINEERING	1.04	81	84	197	199	116	114
17-90	Director DE		2	2	2	2	0	0
17-91	Facility Sys & Equipment		10	11	36	36	26	26
17-92	Mechanical/Fluid Design		42	44	102	103	60	59
17-93	Electrical Design		27	28	57	58	30	29

TABLE 7-11.- SHUTTLE AND GROUND SUPPORT ENGINEERING
BREAKDOWN BY DEPARTMENT

DEPARTMENT: 17-01, 02, 03

NAME: SHUTTLE, GRND SUPT ENGRG
ENGRG INTEGRATION
PROCESS SYS ENGRG

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGEMENT AND STAFF FOR SHUTTLE AND GROUND SUPPORT ENGINEERING DIRECTORATE	ORGANIZATIONAL SIZE AND COMPLEXITY OF ENGINEERING FUNCTIONS
MANAGEMENT DIRECTION FOR ALL VEHICLE PROCESSING AND GSE/FACILITY ENGINEERING MAINTENANCE, TEST, AND DESIGN CHANGES	MANAGEMENT RESPONSIBILITIES LAUNCH RATES
INCLUDES DEPARTMENT DIRECTORS FOR PROJECT ENGINEERING AND PROCESS SYSTEM ENGINEERING	
INCLUDES ONE TECHNICAL STAFF FOR SPECIAL PROJECTS	
PROVIDES TECHNICAL LEADERSHIP OF PROCESSING TEST TEAM FOR IDENTIFYING TIMELY ENGINEERING REQUIREMENTS AND PROBLEM RESOLUTION DURING PROCESSING	
INCLUDES BUSINESS MANAGEMENT PERSONNEL FOR RESOURCE MANAGEMENT STATUS, BUSINESS MANAGEMENT STATUS, BUSINESS OPERATIONS, AND OVERALL ADMINISTRATIVE OPERATIONS OF DEPT 17	
INCLUDES ALL DEPT 17-01 CLERICAL SUPPORT	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

STAFF PERSON TRANSFERRED FROM DEPT 17-2X

DELTA: +2

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-10, 11, 12

NAME: PROJECT ENGINEERING & TEST INTEGRATION
TEST PROJECT ENGINEERING
PROJECT ENGINEERING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O INTEG CONSOLE SUPT FOR POWER-ON TESTING AND LANDING OPS O TEST INTEG FOR GLS/LCC, ORBITER, ET, SRB, CARGO, EMU & MMU O INTEG FUNCTION FOR L-1 DAY BRFGS, LCD SIMULATIONS, RCNs/BLDG 45s, OMI REVIEWS, FLT ANOMALY TRACKING, & SPECIAL TEST O COORDINATION OF FLIGHT H/W ITEMS, MODS, AND VEHICLE PROC O GSE SITE INTEG FOR OPF, OMRF, VAB, SHOPS & LABS, LANDING SITES, MLPs, PADs, & HMF O INTEG FUNCTION FOR OVERALL OMRSD FILE MGMT & RCN/EXCEPTION/WAIVER PROC (INC FILE VI GRN OMRSD) O INTEG FUNCTION FOR RQRMTS, ASSESSMENTS, PACKAGING & IMPLEMENTATION OF FLT/GRND APPLICATION S/W O SYS ANAL FOR ALL SPC ENGRG. CONTINUOUSLY LOOKS FOR ENHANCEMENTS TO SHUTTLE PROCESSING (i.e., TILE AUTOMATION) O TRAINING SERVICES FOR ALL OF SPC ENGRG O PROCUREMENT, S/W DESIGN & O&M SUPPT TO THE PROCESS ENGINEERING COMPUTER SYSTEM (PECS)	O RATE OF FLOW PROC, LAUNCH, MISSION MONITORING & LDG OPS O AMT OF POWER ON TEST SUPT O QTY & COMPLEXITY OF PROG RQMNTS (FOR INTEG) O QTY OF VEHICLE/GSE MODS O AMT OF INTEG REQD DUE TO DESIGN CHGS FOR FLT & GRD GRND OMRSD O ENGRG ENHANCEMENTS, SYS ANALYSIS & TRNG SERVICES RQRD FOR PROCESSING MAINTENANCE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASED TEST REQTS
SUPPORT OPS (7X3 SHIFTING)
ADDED SIGNATURE FOR L III OVERSIGHT
CONSOLE MANNING GUIDELINE CHANGES

PAPERWORK & PREPAREDNESS COMM CHGS (INCL FILE VI OMRSD CLOSED LOOP)
INCREASED LNDG SITE SUPPT AT DFRF
TREAT GSE "MORE LIKE FLIGHT"

IMPROVED ENGRG TRNG (5%)

DELTA: +38

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-20

NAME: ELEC/MECH SYS ENGRG

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O MANAGEMENT OF DEPTS 17-22, 23 & 24	O PROCESSING WORKLOAD O SIZE OF ORGANIZATION
O IN ACCOMPLISHMENT OF TASKS/FUNCTIONS	O MANAGEMENT/ADMINISTRATIVE REPORTING RQMTS
O PROCESS ENGRG REPRESENTATIVE TO THE OMD CONTROL BOARD	O FLOW FREQUENCY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADMIN ASSISTANT CONSOLIDATED INTO 17-01

CLERK/EXPEDITORS LAID-OFF-
-FUNCTION ASSUMED/ABSORBED INTO SUBORDINATE DEPARTMENTS

DELTA: -18

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-22

NAME: ELEC/TELECOMM SYS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE SYS ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATION S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RETEST/CLOSURE 7) OMI/JC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMALY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT-OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O LEVEL OF MANAGEMENT/PROGRAM REVIEW O SUPPORT TO CARGO
O FOR THE FOLLOWING SYSTEMS: COMM & TRACKING (INC C&T STATION) INSTRUMENTATION & HA2 WARNING EPDC & PYROs BOOSTER/GSE ELECTRICAL	
O MAINTAINS/OPERATES BATT LAB/FACT LAB	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

TREAT GSE "MORE LIKE FLIGHT"
IMPROVED ENGRG TRAINING (7.5%)
INCREASED TEST RQMTS
SRB MODIFICATIONS (JOINT HEATERS PLUS DFI)
SUPT OPS (7X3) SHIFTING
INCREASED ENGRG ON FLOOR
INCREASED WAD PREP/CLOSURE TIME
ADDED SIGNATURES FOR LEVEL III OVERSIGHT
CONSOLE MANNING GUIDELINE CHANGES

DELTA: +54

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-23

NAME: AVIONICS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATIONS S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RETEST/CLOSURE 7) DMI/JC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMLAY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT --OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O SHIFT COVERAGE FOR OPERATIONS O LEVEL OF CHANGE WITHIN SYSTEM O LEVEL OF MANAGEMENT/PROGRAM REVIEW O S/W DEVELOPMENT ACTIVITY O SAIL USE REQUIREMENTS
O FOR THE FOLLOWING SYSTEMS: DATA PROCESSING SYSTEM (+RMS) GN&C MECHANISMS FLIGHT SOFTWARE	
O MAINTAIN/OPERATE KATS + DIGITAL LAB O SUPPORT RMS OFF-LINE PROCESSING O SUPPORT S/W DEVELOPMENT PROCESS O COORDINATION OF SAIL UTILIZATION BY KSC	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

IMPROVED ENGRG TRAINING (8.5%)
INCREASED TEST RQMNTS
SUPPORT OPERATIONS (7X3) SHIFTING
INCREASED ENGRG ON THE FLOOR
INCREASED WAD PREPARATION/CLOSURE TIME
ADDED SIGNATURES FOR LEVEL III
CONSOLE MANNING GUIDELINE CHANGES
INCREASED MGMT/PROGRAM REVIEW

DELTA: +35

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-24

NAME: ORBITER MECH/GSE SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATIONS S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RETEST/CLOSURE 7) DMI/JSC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMALY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT --OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O SHIFT COVERAGE FOR OPERATIONS O LEVEL OF CHANGE WITHIN SYSTEM O LEVEL OF MANAGEMENT/PROGRAM REVIEW O GSE SPECIAL PROJECT ACTIVITY O LEVEL OF ENGRG INVOLVEMENT IN ROUTINE TPS OP O FREQUENCY OF PLANNED/UNPLANNED HANDLING/MOVE OPERATIONS
O FOR THE FOLLOWING SYSTEMS: STRUCTURES TPS/TCS (TILE) OPF GSE	
O SUPPORT ALL ORBITER HANDLING OPNS O SUPPORT GENERIC GSE PROJECTS SUCH AS PRESSURE VESSEL CERT & SHOP AID CONVERSIONS O SUPPORT ALL VEHICLE H/W MOVE OPERATIONS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

REDEFINED TILE PROC PROCEDURES SIGNIFICANTLY INC ENGRG INVOLVEMENT (+24 ENGRS)
IMPROVED ENGRG TRAINING (5%)
SUPPORT OPERATIONS (7X3) SHIFTING
INCREASED ENGRG ON FLOOR
INCREASED DFRF LANDINGS
TREAT GSE "MORE LIKE FLT"
INCREASED WAD PREP/CLOS TIME
ADDED SIGNATURS FOR LEVEL III
STRUCTURAL/ZONAL INSP PROG IMPLE
GSE PRESS VESSEL CERT PROGRAM

DELTA: +63

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-50 NAME: FLUID/MECH SYSTEM

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O MANAGEMENT OF DEPTS 17-51, 52 & 53 IN ACCOMPLISHMENT OF THEIR FUNCTIONS/TASKS	O PROCESS WORKLOAD O SIZE OF ORGANIZATION
O PROCESS ENGRG REPRESENTATIVE TO THE INCIDENT ERROR REVIEW BOARD (IERB)	O MANAGEMENT/ADMINISTRATIVE REPORTING RQMTS.
O PROCESS ENGRG REPRESENTATIVE AT THE PRIME MATERIALS REVIEW BOARD	O LOW FREQUENCY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-51 NAME: FLUIDS SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATIONS S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RETEST/CLOSURE 7) OMI/JC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMALY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT --OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O SHIFT COVERAGE FOR OPERATIONS O LEVEL OF CHANGE WITHIN SYSTEM O LEVEL OF MGMT/PROGRAM REVIEW O CARGO SUPPORT RQMTS O MISSION/FLIGHT DURATIONS O NON-KSC LANDINGS
O FOR THE FOLLOWING SYSTEMS: ECLSS OMS/RCS APU/HPU/HYDRAULICS O MAINTAINS/OPERATES LIOH LAB O MAINTAINS/USES HMF FOR OMS/RCS OFFLINE WORK	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

TREAT GSE "MORE LIKE FLIGHT"	INCREASED WAD PREPARATION/CLOSURE TIME
IMPROVED ENGRG TRAINING (7.7%)	ADDED SIGNATURES FOR LEVEL III OVERSIGHT
INCREASED TEST RQMTS	CONSOLE MANNING GUIDELINE CHANGES
SUPPORT OPS (7X3) SHIFTING	INCREASED DFRC LANDINGS
INCREASED ENGRG ON FLOOR	STRUCTURAL INSP & PRES VES CERT PROGRAM

DELTA: +49

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-52

NAME: MPS/CRYOGENIC SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATIONS S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RESTEST/CLOSURE 7) OMI/JC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMALY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT --OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O SHIFT COVERAGE FOR OPERATIONS O LEVEL OF CHANGE WITHIN SYSTEM O LEVEL OF MGMT/PROGRAM REVIEW O CARGO SUPPORT RQMTS
O FOR THE FOLLOWING SYSTEMS: MPS & SSME FUEL CELL/PRSD LOX/LH2 ET PNEUMATICS O SUPPORTS SSME SHOP W/ROCKETDYNE O SUPPORTS PROPULSION SYSTEM INTEG GROUP FOR KSC (PSIG)	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

TREAT GSE "MORE LIKE FLIGHT"	INCREASED WAD PREPARATION/CLOSURE TIME
IMPROVED ENGRG TRAINING (11.3%)	ADDED SIGNATURES FOR LEVEL III OVERSIGHT
INCREASED TEST RQMTS (MPS)	CONSOLE MANNING GUIDELINE CHANGES
SUPPORT OPS (7X3) SHIFTING	INCREASED DFRC LANDINGS
INCREASED ENGRG ON FLOOR	STRUCTURAL INSP & PRES VES CERT PROGRAM

DELTA: +45

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-53

NAME: PAD/MECHANICAL SYSTEMS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O PERFORMS VEHICLE & GSE ENGRG FUNCTIONS/ TASKS OF 1) WAD PREP/PROCESSING/CLOSURE 2) GOAL APPLICATIONS S/W SUPPORT 3) CONFIG/RQMT CHANGE ASSESSMENTS 4) SUBSYSTEM/INTEG TESTING/CIG RETEST 5) DATA REVIEW & ANOMALY ID/RESOLUTION 6) IPR/PR DISPOSITION/RETEST/CLOSURE 7) OMI/JC MAINTENANCE 8) SPECIAL TEST REQUESTS 9) VEHICLE MODS/GSE MODS 10) INFLIGHT ANOMALY RESOLUTION 11) COMMIT TO LAUNCH	O TEST REQUIREMENTS O NO OF VEHICLES IN FLOW O FLOW/FLIGHT RATE O WAD PREPARATION/CLOSURE REQUIREMENTS O DESIGN CENTER/DEV CONTRACTOR INVOLVEMENT --OVERSIGHT O CRITICALITY OF/HAZARDS WITHIN SYSTEMS O SHIFT COVERAGE FOR OPERATIONS O LEVEL OF CHANGE WITHIN SYSTEM O LEVEL OF MGMT/PROGRAM REVIEW O FREQUENCY OF VEHICLE MOVES O ENGRG INVOLVEMENT IN SRB STACKING OPS O SRB/ET BUILDUP TIMELINE O LETF TEST ACTIVITY
O FOR THE FOLLOWING SYSTEMS: LAUNCH ACCESSORIES ECS/PVD ET/SRB MECHANICAL O PRIMARY USER OF RPSF OFF-LINE PROCESSING O SUPPORTS ALL MOVE OPS FOR PURGE AIR RECONFIG O SUPPORTS TEST OPS IN LETF	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

TREAT GSE "MORE LIKE FLIGHT"	INCREASED ENGRG ON FLOOR
IMPROVED ENGRG TRAINING (9.0%)	ADDED PROGRAMS SIGNATURES FOR LEVEL III OVERSIGHT
INCREASED TEST RQMTS (SRB)	INCREASED WAD PREP/CLOSURE TIME
SRB JOINT REDESIGN	INCREASED DFRC LANDINGS
SUPPORT OPS (7X3) SHIFTING	STRUCTURAL INSP & PRES VES CERT PROGRAM

DELTA: +43

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-60

NAME: ENGINEERING TECHNOLOGY

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O OVERALL STUDY FOR PROCESS ENGINEERING ENHANCEMENTS AND TECHNICAL TRAINING	O FREQUENCY AND COMPLEXITY OF LAUNCH TEAM SIMULATIONS
O CONCENTRATES ON FUTURE ENHANCEMENTS TO SPC ENGINEERING PROCESSING	O QUANTITY OF EFFORT DIRECTED TO DEVELOPMENT OF ENHANCEMENTS FOR PROGRAM BENEFIT
O PROJECTS INCLUDE SIMULATION TRAINING, KATS SUPPORT, ORBITER STRUCTURAL INSPECTION, TILE AUTOMATION (AWADS), AND SHUTTLE CONNECTOR ANALYSIS NETWORK (SCAN)	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

THE PROJECTED MANPOWER SAVINGS FOR AUTOMATED WORK AUTHORIZATION DOCUMENTATION SYSTEM (AWADS) AND SHUTTLE CONNECTOR ANALYSIS NETWORK (SCAN) HAS ALREADY BEEN FACTORED INTO EACH DEPT 17 MANPOWER PROJECTION.

DELTA: +1

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-70

NAME: SITE LIAISON

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O ON-SITE ENGR FOR ALL OF SPC ENGRG-- ALL SHIFTS, ALL VEHICLE SITES (LIAISON ENGRG) O WORKS ENGRG INTERFACE PROBLEMS W/LOGISTICS & PP&C O DISPOSITIONS SYS ENGRG PAPER W/THEIR CONCURRENCE O REVIEWS PAPER FOR ENGRG ACTIONS & PROVIDES VERBAL CLARIFICATION OF PAPER PROBLEMS WHEN RQRD AT PCC O COORD CONSTRAINT LIST & REAL TIME SHOP & KICS SCHEDULE CHANGES O SUPPORTS ONE LIASON ENGR AT DFRC O LOGS & FILES WORK AUTHORIZATION DOCUMENTS FOR SYSTEMS ENGRG ACTION O PERFORMS ROUTINE ENGRG EVALUATION OF GSE MOD PKGS & PREPARES APPROPRIATE WORK AUTHORIZATION DOCUMENTS TO INCORPORATE MODS	O RATE OF FLOW PROCESSING, LAUNCH & LANDING OPERATIONS O QUANTITY OF DOCUMENTATION REQUIRING ENGRG DISPOSITION O AMOUNT OF PROBLEMS ACROSS GEOGRAPHICAL AREAS ON ALL SHIFTS REQUIRING ENGRG RESOLUTION O QUANTITY OF ASSESSMENTS & PREPARATION REQUIRED FOR GSE MOD PACKAGES

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

O PREV GROWTH RQMTS FOR LIAISON COVERAGE REDUCED DUE TO PROGRAM RQMT FOR INC ENGRG FLOOR SUPT
O CREATION OF NEW GSE MOD ASSESS & WAD PREP GROUP TO MINIMIZE GSE MOD WORK BACKLOG & INCREASE CAPABILITY OF GSE TO SUPPORT PROCESSING ACTIVITIES
O ADDITION OF REQUIRED LIAISON SUPPORT AT PAD
O PROVIDE ROUTINE 7/3 SHIFT COVERAGE

DELTA: +18

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-04	NAME: DIR, GROUND SYSTEMS DESIGN ENGINEERING
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR'S OFFICE	PROVIDE ENGINEERING MANAGEMENT OF LINE ORGANIZATION
STAFF	WORK CONTROL
	BUDGETS
	PERSONNEL
	SECURITY
	TRAINING

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

NO STS 51-L IMPACT. TO PROVIDE SUPPORT FOR THE INCREASED MANPOWER IN DEPARTMENTS 17-8X AND 17-9X IN THE ABOVE AREAS. IN ADDITION, MODIFICATION COST ANALYSES AND DELTA: GENERAL SUPPORT TO THE DIRECTOR'S OFFICE IS PROVIDED. ACTIVE WORK CONTROL JOBS HAVE INCREASED FROM 1000 TO 1680 AS OF WEEK ENDING 5/22/87. IMPACTS: FY 1990 ASSUMPTION IS THAT WORKLOAD WILL NOT DECREASE, BASED ON LARGE BACKLOG OF ENGINEERING SUPPORT REQUESTS (ESRs) BEING GENERATED EACH MONTH.

DELTA: +4

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-80	NAME: DIR, PROJECT INTEGRATION
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROJECT ENGINEERING MANAGEMENT	PROJECT ENGINEERING LINE MANAGEMENT
ENGINEERING DOCUMENTATION	REVIEW/UPDATE OPERATION & MAINTENANCE DOCUMENTATION (OMD) AS A RESULT OF ENGRG CHANGES
EMPLOYEE SERVICES	PIRNs, IRNs, SIDs
	ENGINEERING DOCUMENTATION REVIEW & RELEASE
	FACILITY/SYSTEMS CONFIGURATION CONTROL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

THERE ARE CURRENTLY 1400 ESRs IN THE SYSTEM WITH AN INCOMING AVERAGE RATE OF 140-150 ESRs PER MONTH. AVERAGE CLOSING RATE IS AT 100-110 PER MO. DOCUMENTATION UPDATES ON 152 CRITICAL SYSTEMS & 350 NON-CRITICAL SYSTEMS ARE PERFORMED BY THIS ORGANIZATION. A MINIMUM ESTIMATED REVIEW & UPDATE OF DOCUMENTATION REQUIRED IN 1990 IS 22,450 MH. RESPONSIBLE FOR CONDUCTING INTEGRATED REQUIRE HAZARD ANLYSES OF ENGRG SUPPORT REQUESTS. ESR IMPLEMENTATION THROUGH DESIGN RELEASE AUTHORIZATIONS REQUIRE HAZARD ANALYSES, SYSTEMS INTERFACE DOCUMENTS, INTERFACE CONTROL DOCUMENTS AS ACCOMPANYING DOCUMENTATION (OFTEN NOT COMPLETED IN THE PAST) & IS NOW MANDATORY. POST 51-L REVIEWS DICTATED REQUIREMENT TO TREAT GSE MORE LIKE FLIGHT HARDWARE IN TERMS OF CHANGE CONTROL & OMRSDs. DOCUMENTATION UPDATES ARE MAINTAINED ON 152 CRITICAL SYSTEMS AND 350 NON-CRITICAL SYSTEMS. MINIMUM ESTIMATED REVIEW & UPDATE OF 1990 DOCUMENTATION IS 22,450 MANHOURS.

IMPACTS: STAFF OF 12 (PRE 51-L, LSOC WAS 0; NOW 12) AVAILABLE TO DO OMD ENGRG DOCUMENTATION; THIS WORK WAS PREVIOUSLY (INADEQUATELY) DONE BY PRC. CLOSED LOOP OMD/OMRSD (+3) IS NEW REQUIREMENT. INTEGRATION ANALYSES OF FACILITY SYSTEMS & EQUIPMENT ESRs (WAS 4, is 9) ALSO DONE BY PRC BEEN AUGMENTED DUE TO MANDATORY NATURE OF REQUIREMENT.

DELTA: +21

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-81

NAME: GSE PROJECTS MANAGEMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROJECT ENGINEERING MGMT PROJECT SCHEDULES PROJECT MGMT CONTROL COST ESTIMATES/BUDGET COST TRACKING PROJECT ANALYSIS & TRACKING	CONTINUING GSE/FACILITY/SYSTEMS MODS & NEW RQMTS RESULTING FROM PROGRAM & FLIGHT ELEMENT CHANGED RQMTS STS PROGRAM ANOMALIES RELATIVE TO FACILITIES & GSE DEMANDING SPECIAL TASK ASSIGNMENT TRANSPORTATION & HANDLING PRESSURE VESSEL ACTIVITY SAFETY ISSUES MISHAP INVESTIGATIONS SYSTEMS PERFORMANCE ANALYSIS
SPECIAL PROJECTS PROJECT SCHEDULES	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

PROJECT ENGRG (PE) IS PERFORMED ON 100 TO 110 ESRs PER MONTH. THERE ARE 1400 ESRs CURRENTLY IN THE SYSTEM WITH AN AVERAGE NUMBER OF 30 JOBS BEING ASSIGNED TO EACH PROJECT ENGINEER AT ANY ONE TIME. AN AVERAGE OF 100 HOURS PER JOB IS EXPENDED. EACH PE HAS 1 1/2 YEARS OF WORK ASSIGNED AT THIS TIME WITH AN INCREASING BACKLOG. IN ADDITION, THERE ARE 292 OPEN PROBLEM REPORTS (PRs) IN THE SYSTEM WITH AN AVERAGE OF 30 INCOMING PER WEEK AND AN AVERAGE CLOSING RATE OF 25.

IMPACTS: VLS SHUTDOWN HAS DECREASED PROJECT ENGINEERING REQUIREMENT FOR COMMON/MOD COMMON EQUIPMENT (WAS 6, IS 3). PRESSURE VESSEL CERT/RECERT IS A NEW REQUIREMENT (+4). FACILITY SYSTEMS AND EQUIPMENT PROJECTS (WAS 17, IS 39) DRIVEN BY SUPPORT REQUIRED (TO 17-80, -90, -91, -92) FOR RESPONDING TO ESR TRAFFIC AND OPEN PROBLEM REPORTS.

DELTA: +20

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-82

NAME: FACILITY PROJECTS MANAGEMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ACTIVATION & TURNOVER PROVIDE ON-SITE DAILY INSPECTION/OBSERVATION OF MODS OR CONSTRUCTION OF IN-LINE LAUNCH FACILITIES & SUPPORT FACILITIES TO RESPOND TO CONTINUING STS PROGRAM CHANGES	PROVIDE MGMT CONTROL ON VERIFICATION OF SYSTEMS & EQUIP TO ENSURE COMPLIANCE WITH ENGRG DESIGN/DRAWINGS
COST ESTIMATING/COST ENGINEERING	PROVIDE A SERVICE TO THE DESIGN ENGRG SUPPORT FOR COST ANALYSIS/ESTIMATES IN MODIFICATION PROJECTS & ANALYSIS ON EXISTING DESIGNS TO ENSURE MINIMUM MAINTENANCE COST RQMTS
FACILITY PROJECTS DEVELOP SCHEDULES TEAM LEADERSHIP MONITOR PROGRESS/SCHEDULE MONITOR COSTS	PROVIDE DAILY MGMT CONTROL ON FACILITY PROJECTS TO ENSURE COMPLIANCE WITH ENGRG SPECIFICATIONS FOR IN-LINE LAUNCH FACILITIES AS WELL AS SUPPORT FACILITIES
FIELD ENGINEERING DESIGN ENGRG SERVICE FOR TROUBLE SHOOTING & PROBLEM RESOLUTION FOR DESIGN PACKAGE IMPLEMENTATION	PROVIDE ON-SITE COORDINATION AND LIAISON BETWEEN IMPLEMENTING ORGANIZATIONS. FOLLOW CHANGE IMPLEMENTATION PROGRESS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

FACILITY PROJECTS IN THE AMOUNT OF 16M AND 12M ARE SCHEDULED TO BE ACCOMPLISHED IN FY-89 AND FY-90 RESPECTIVELY. APPROXIMATELY .2% (.002) OF THIS COST IS FACILITY PROJECTS MANPOWER (OR 64,000 MANHOURS EFFORT) EQUALING 17 MEN PER YEAR. IN ADDITION, COST ESTIMATING AT THE RATE OF 100 FACILITY TYPE ESRs PER YEAR WILL BE ACCOMPLISHED WITH AN AVERAGE OF 95 HOURS PER JOB. ACTIVATION/TURNOVER DOCUMENTATION IS REQUIRED ON ALL FACILITY PROJECTS.

IMPACTS: INCREASES ATTRIBUTED TO TRANSITION TO LSOC OF PRC WORK. (ACTIVATION & TURNOVER: WAS 8, IS 15; COST EST'G/ENG'R: WAS 1, IS 5: FACILITY PROJECTS: WAS 5, IS 17; FIELD ENG'R: WAS 2, IS 10. (NOTE: NO CHANGE ORDER--NEW FACILITIES OR SUBSTANTIAL MODS--IS INCLUDED IN REVISED ESTIMATES.)

DELTA: +28

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-91

NAME: SYSTEMS DESIGN & ANALYSIS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
FACILITY SYSTEMS & EQUIPMENT DESIGN/ANALYSIS PROVIDE DESIGN FOCAL POINT FOR ENGRG REVIEW ALL COMPLETED DESIGN(S) ANALYZE REQUIREMENTS TO ENSURE COMPLIANCE ASSURE SYSTEMS DESIGN PERFORMANCE THRU END-TO-END ANALYSIS LAUNCH READINESS ASSESSMENTS ASSURE SYSTEMS/EQUIPMENT CONFIG CONTROL	CONTINUING GSE/FACILITY/SYSTEMS MODIFICATIONS & NEW REQUIREMENTS RESULTING FROM PROGRAM & FLIGHT ELEMENT CHANGED REQUIREMENTS. INCLUDES BUT IS NOT LIMITED TO: SENSOR DEVELOPMENT SPECIAL STUDIES SAFETY PROJECTS OPERATIONS SUPPORT ACTIVATION/TURNOVER OF FACILITIES & SYSTEMS COMMON/MOD COMMON EQUIPMENT SYSTEMS DESIGN ANALYSIS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

MANPOWER DRIVER: THIS SYSTEMS GROUP FORMED 1/87 TO RECEIVE ALL DESIGN ENG'R TASKS AND DO SYSTEMS ENGINEERING & INTEGRATION. DETAILED DESIGN WORK DONE IN 17-92 & 17-93. 17-91 CONFIRMS WORK ACCURACY PRIOR TO TRANSMITTING PACKAGE TO 17-80.'

NASA CCB APPROVED ENGINEERING SUPPORT REQUESTS BACKLOG OF 1400; LSOC ESR BACKLOG (i.e., APPROVED BY LSOC BOARD) IS 1000. AVERAGE 100 HRS DESIGN TIME (17-90, -91, -92) PER ESR. 2-YR HISTORICAL AVERAGE: 140-150 NEW ESRs GENERATED PER MONTH. AVERAGE CLOSING RATE IS 100-110/MO. FIELD ESRs GENERATED AS RESULT OF PROBLEM REPORT HAVE HIGH PRIORITY, APPROXIMATELY 1000 OF THESE NOW IN THE SYSTEM. SPECIFIC RQRMNTS INCLUDE: SENSOR DEVELOPMENT+, SPECIAL STUDIES+ (e.g., PAD EMERGENCY EGRESS ALTERNATIVES), SHOP AIDS DOCUMENTATION/CONVERSION (TO GSE)*, OMD/OMRSD CLOSED LOOP*, SAFETY PROJECTS+, OPERATIONS SUPPORT+, ACTIVATION/TURNOVER OF FACILITIES & SYSTEMS+. (* = NEW; + = AUGMENTED)

IMPACTS: INCREASE INCLUDES TRANSFER TO LSOC OF WORK PREVIOUSLY DONE BY PRC. WORK BACKLOG DRIVEN, COUPLED WITH NEW RQMNTS. SYSTEM DESIGN ANALYSIS EFFORT (+13). INCREASED MANPOWER LEVEL NOT CONSISTENT WITH TIMELY WORKING OFF OF BACKLOG.

DELTA: +26

TABLE 7-11.- CONTINUED

DEPARTMENT: 17-92

NAME: MECHANICAL/FLUIDS DESIGN

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE MECHANICAL/FLUIDS DESIGN ENGINEERING TO SUPPORT ALL STS GROUND FACILITIES, SYSTEMS & EQUIPMENT - MODIFICATION ANALYSIS - ANOMALY ANALYSIS - MODIFICATION CONCEPT & DESIGN - MOD DRAWINGS - DESIGN NEW SYSTEMS NOTE: THESE FUNCTIONS ARE PERFORMED ON APPROXIMATELY 75 SYSTEMS AND ALL MAJOR FACILITIES, INCLUDING THE FOLLOWING MAJOR ENGINEERING DISCIPLINES: MECHANICAL, FLUIDS STRUCTURAL/CIVIL, GASES PNEUMATICS, PROPELLANTS	CONTINUING GSE/FACILITY/SYSTEMS MODIFICATIONS MODIFICATIONS & NEW REQUIREMENTS RESULTING FROM PROGRAM & FLIGHT ELEMENT CHANGE REQUIREMENTS. - SENSOR DEVELOPMENT - SPECIAL STUDIES - SAFETY PROJECTS - PRESSURE VESSEL RECERT - OPERATIONS SUPPORT ACTIVIATION/TURNOVER OF FACILITIES/ SYSTEMS - FACILITY PROJECTS - CLS MODIFICATIONS - SYSTEM DESIGN ANALYSIS - SHOP AIDS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DRIVER: SEE 17-91 FOR BACKLOG. SPECIFIC REQUIREMENTS INCLUDE: SENSOR DEVELOPMENT+, SPECIAL STUDIES+, SAFETY PROJECTS+, PRESSURE VESSEL RECERTIFICATION*, DOCUMENTATION OF SHOP AIDS*, CLS MODIFICATIONS*, OPERATIONS SUPPORT+.

IMPACTS: INCREASE INCLUDES TRANSFER TO LSOC OF WORK PREVIOUSLY DONE BY PRC. WORK BACKLOG DRIVEN, COUPLED WITH NEW REQUIREMENTS. INCREASED MANPOWER LEVEL NOT CONSISTENT WITH TIMELY WORKING OFF OF BACKLOG.

DELTA: +60

TABLE 7-11.- CONCLUDED

DEPARTMENT: 17-93

NAME: ELECTRICAL/ELECTRONIC DESIGN

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE ELECTRICAL/ELECTRONIC DESIGN ENGINEERING TO SUPPORT ALL STS GROUND FACILITIES AND EQUIPMENT - MODIFICATION ANALYSIS - ANOMALY ANALYSIS - MODIFICATION CONCEPT & DESIGN - MODIFICATION DRAWINGS NOTE: THESE FUNCTINS ARE PERFORMED ON APPROX 75 SYSTEMS AND ALL MAJOR FACILITIES. DISCIPLINES INCLUDE: ELECTRICAL POWER ELECTRICAL CONTROLS ELECTRICAL SYSTEMS	CONTINUING GSE/FACILITY/SYSTEMS MODIFICATIONS AND NEW REQUIREMENTS RESULTING FROM PROGRAM AND FLIGHT ELEMENT CHANGED REQUOIREMENTS INCLUDES BUT IS NOT LIMITED TO: - SENSOR DEVELOPMENT - SPECIAL STUDIES - SAFETY PROJECTS - OPERATIONS SUPPORT - FACILITY PROJECTS - CLS/MODIFICATIONS - SYSTEM DESIGN ANALYSIS - SHOP AIDS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DRIVER: SEE 17-91 FOR BACKLOG. SAME SPECIFIC REQUIREMENTS AS 17-92, EXCEPT FOR PRESSURE VESSEL RECERT.

IMPACTS: INCREASE TRANSFER TO LSOC OF WORK PREVIOUSLY DONE BY PRC. WORK BACKLOG DRIVEN, COUPLED WITH NEW REQUIREMENTS (+15). INCREASED MANPOWER LEVEL NOT CONSISTENT WITH TIMELY WORKING OFF OF BACKLOG.

DELTA: +30

7.7 2X-XX KSC OPERATIONS

As indicated previously in this report, the number of equivalent manyears for the hands-on processing workforce projected for FY 1990 will decrease from the level experienced in the six months prior to STS 51-L. The very high levels of overtime worked will be reduced by increasing the number of technicians and supervisors by 110, but assuming a 1% overtime factor results in an overall decrease equivalent to 76 manyears - from 1243 to 1167. LSOC management personnel justified this change on the basis of having a more efficient operational capability due to increases in supporting areas (engineering, quality control (QC), facilities and equipment O&M). The OPF managers, however, point out that the 1% overtime assumption is not credible since it was based largely on the implementation of the full "rolling wave" (7 crews) approach. The change to a 3-crew approach, a modified work week, the use of personnel from non-critical path facilities to supplement the critical path workforce, and the use of overtime to enable weekend coverage and occasional power-on third shifts was considered an appropriate means of avoiding the otherwise inefficient use of the workforce which results from the original assumption. Coupled with factors which indicate an increased workload in given areas, such as tile processing timelines having more than doubled due to new OMI constraints, the 1% overtime assumption is regarded by the team as needing revision.

In terms of relative manpower levels to processing facilities, revising the projected equivalent manpower level for the critical path facility, the OPF, is not a major cost driver. The OPF operations, OPF GSE, and TPS operations departments accounted for about 562 equivalents prior to STS 51-L. Augmenting the overtime level to 5% would result in an increase of only approximately 20 manyears.

The KSC Operations organization is shown in Figure 7-7. Table 7-12 is an operations manpower bottoms-up analysis, and a breakdown by department is shown in Table 7-13.

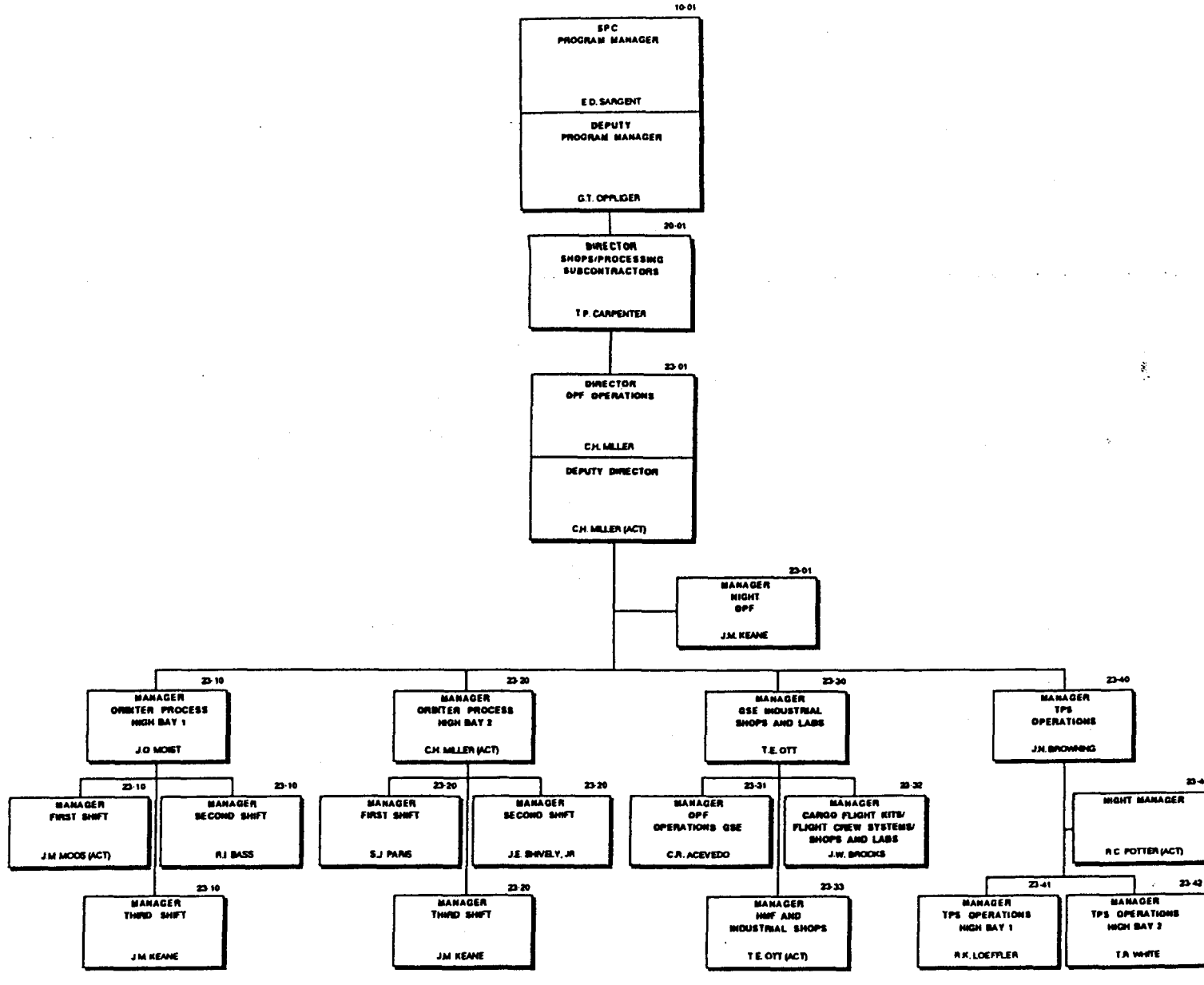

Figure 7-7.- KSC Operations organizational chart.

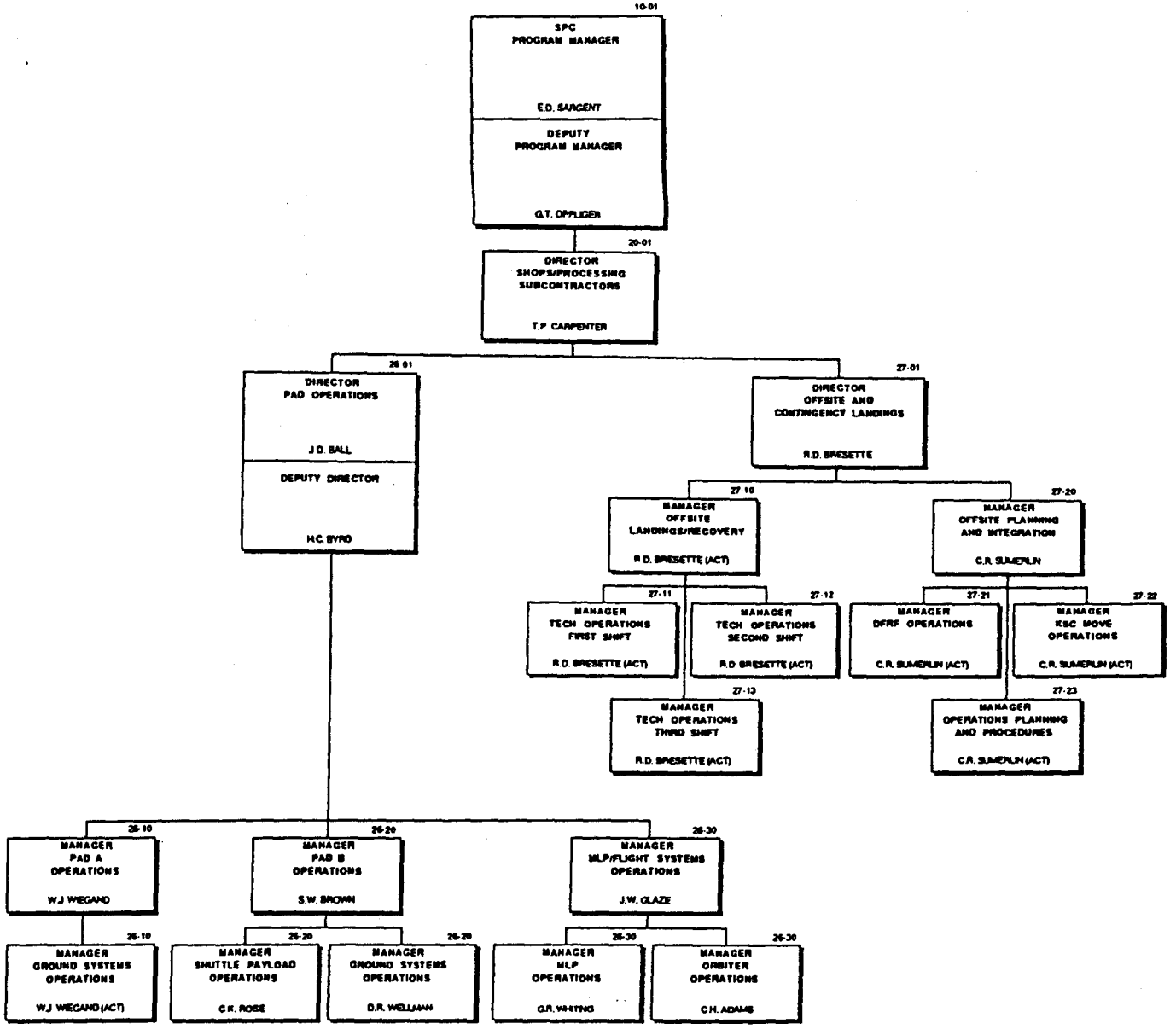

Figure 7-7.- Concluded.

TABLE 7-12.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
KSC OPERATIONS

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
2X-XX	KSC OPS DIRECTORATE	1.18	1050	1243	1156	1167	106	-75
20-01	KSC OPS DIRECTOR		12	12	8	8	-4	-4
23-XX	OPF OPERATIONS	1.17	606	709	582	588	-24	-121
23-01	OPF DIRECTOR		8	9	65	66	57	56
23-10	OPF HB-1 DIVISION		117	137	102	103	-15	-34
23-20	OPF HB-2 DIVISION		124	145	102	103	-22	-42
23-3X	GSE INDUST. SHOPS/LAB DIV		210	246	211	213	1	-33
23-4X	TPS DIVISION		147	172	102	103	-45	-69
23-3X	GSE SHOPS /LABS DIVISION	1.17	210	246	211	213	1	-33
23-30	GSE INDUST. SHPS/LAB		57	67	4	4	-53	-63
23-31	OPF GSE DEPT		64	75	133	134	69	59
23-32	VAB SHOPS/LABS DEPT		61	71	44	44	-17	-27
23-33	MMF OPERATIONS DEPT		28	33	30	30	2	-2
23-4X	TPS OPERATIONS	1.17	147	172	102	103	-45	-69
23-40	TPS OPERATIONS DIVISION		12	14	4	4	-8	-10
23-41	TPS HB-1 DEPT		67	78	49	49	-18	-29
23-42	TPS HB-2 DEPT		68	80	49	49	-19	-30
26-XX	PAD OPS DIRECTOR	1.21	406	491	462	467	56	-25
26-01	PAD OPS DIRECTOR		10	12	10	10	0	-2
26-10	PAD A OPERATIONS		228	276	136	137	-92	-139
26-20	PAD B OPERATIONS		103	125	136	137	33	13
26-30	MLP/FLT SYSTEMS		65	79	180	182	115	103
27-XX	OFFSITE & LANDING/RECOV	1.17	26	30	104	105	78	75
27-01	OFFSITE LANDING/RECOV DIR		1	1	4	4	3	3
27-10	OFFSITE LANDING/RECOVERY		25	29	37	37	12	8
27-2X	OFFSITE PLANNING/INTGRTN		0	0	63	64	63	64
27-2X	OFFSITE PLANNING/INTEGRTN	1.00	0	0	63	64	63	64
27-21	OFRF OPERATIONS DEPT		0	0	10	10	10	10
27-22	KSC MOVE OPS DEPT		0	0	25	25	25	25
27-23	OPS PLANS/PROCEDURES DEPT		0	0	28	29	28	29

TABLE 7-13.- KSC OPERATIONS BREAKDOWN BY DEPARTMENT

DEPARTMENT: 20-01	NAME: DIR, KSC OPERATIONS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR/MGMT OF PROCESSING FROM LANDING TO LAUNCH	DIRECT OPERATION OF FACILITIES AND PERSONNEL REQUIRED TO PROCESS SHUTTLE FROM LANDING TO LAUNC

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 TRANSFER OF PERSONNEL

DELTA: -4

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-01	NAME: DIR, OPF OPERATIONS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR/MGMT OF OPF DIRECTORATE	DIRECTION AND CONTROL OF ALL ORBITER STAND-ALONE OPERATIONS
	ADMINISTRATIVE, SECURITY, FINANCE AND SUPPORT FOR OPF DIRECTORATE
MANAGEMENT OF OPF OPERATIONS	DIRECTION & CONTROL OF ALL TASKS REQUIRED TO PROCESS ORBITER
ORBITER ACCESS CONTROL/AREA SECURITY	MONITORS INGRESS & EGRESS SECURITY CONTROL OF ORBITERS IN HIGH BAY

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 INCREASED OMI'S

0 INCREASED FREQUENCY OF OMRSD/MAINT DOCUMENTATION AND MAINTENANCE

0 MORE INVOLVED TRAINING AND CERTIFICATION REQUIREMENTS - REDUCED CERT SPANS.

0 INCREASED SIGNATURES AND PROCESSING TIME FOR PRACA ITEMS/WADS

DELTA: +57

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-10/20	NAME: MGR, ORBITER PROC H81/H82
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ORBITER FWD PROCESSION PER HIGH BAYS	POWER UP, DOWN, CREW HATCH PREPS, CREW QUARTERS PREP, MODS, PRS
(INCLUDE MID, AFT STATEMENTS)	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- INCREASED PR, TDS, DEVIATION AND PRACA SYSTEM REACTION/SPANS.
- OVERCONTROL OF FLOOR PAPER (SATELLITE TAIRS WITHDRAWN)

DELTA: -37

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-30, 31	NAME: MGR, GSE INDUSTRIAL SHOPS & LABS MGR, OPS GSE
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
OPF GSE/MAINTAIN, CERTIFY AND REPAIR GSE	PRs 256/MONTH
SUPPORT ORBITER TESTING & MAINTENANCE	GSE WAs 200/MONTH

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- PRE 51L QUALITY CONTROL IN CLOSURE LOOP ONLY
- POST 51L COMPLETE QC INVOLVEMENT IN GSE PAPER CYCLE
- CIL & FMEA REVIEWS = ADDED MAINT, WAIVER PROCESSING AND VOLUMES OF PAPER PROCESSING

DELTA: +16

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-32	NAME: MGR, CARGO/FLT KITS/CREW SYS/ SHOP & LABS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
VAB SHOPS AND LABS/OPERATE & MAINTAIN FLT CREW EQUIPMENT	VAB SHOPS & LABS OPERATE 5 DAYS/ 2 SHIFTS WITH CONTINGENCY OVERTIME & ODD WORK WEEKS
OPERATE & MAINTAIN FLIGHT KITS/CARGO LABS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- 0 FUNCTIONS TRANSFERRED TO DEPT 23-31 (-23)
- 0 OVERTIME REDUCTION INCREASED (+6)

DELTA: -17

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-33	NAME: MGR, HMF & INDUSTRIAL SHOPS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
HMF OPERATIONS/OPERATE HYPERGOLIC MAINTENANCE FACILITY	HMF OPERATES 5 DAY/2 SHIFT OPERATION WITH SPOT ODD WORK WEEKS AND OVERTIME FOR CONTINGENCIES
PROCESS & REPAIR FRCS & OMS PODS FOR ALL ORBITERS	
OPERATE AND MAINTAIN GSE AT HMF SITES	
OPERATE ORDNANCE LAB	TEST, STORE, ISSUE NASA STANDARD INITIATORS & ALL PYRO BUILDUP

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- 0 REDUCE OVERTIME FROM 17% TO .1% (3)
- 0 CONSOLIDATE ORDNANCE AND HMF OPERATIONS (-1)

DELTA: +2

TABLE 7-13.- CONTINUED

DEPARTMENT: 23-41/42/40

NAME: MGR, TPS OPS H81/H82
MGR, TPS OPNS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)	
OPF THERMAL PROCESSING HIGH BAYS 1 & 2	TPS WAD WORK FLOW INDICATORS:	
MAINTENANCE OF ALL ORBITER TPS	TILES REPLACED	250
	FIBS REPLACED	30
REPAIR FLIGHT AND GROUND DAMAGE	GAP FILLERS REPLACED	550
	PRs WORK	850
PERFORM OFFSITE TPS OPERATIONS	DRs WORK	200
	PCR DATA SHEETS	2900
	OMI'S	7

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- ALL TPS TASKS ARE 100% OMI CONTROLLED, ANY CHANGES REQUIRED DEMANDS EO'S TO OMI-VERY LENGTHY PROCESS - COULD RESULT IN WORK STOPPAGE.
- DEDICATED PERSONNEL TO CERTAIN TASKS HAS ELIMINATED CROSS TRAINING CAPABILITIES, REQUIRING ADDITIONAL PERSONNEL.
- QUALITY SURVEILLANCE HAS INCREASED FROM 20% to 90% ON ALL DOCUMENTS AND TASKS SLOWING DOWN PRODUCTIVITY.
- ENGINEERING HAS DEVELOPED NEW DATA SHEETS THAT REQUIRES ADDITIONAL TRAINING AND MUST CONTINUE TO MAKE CHANGES TO ELIMINATE CONFLICT OF INTERPRETATION.
- A TASK THAT REQUIRED 1.0 HOURS TO COMPLETE A YEAR AGO, REQUIRES 2.2 HOURS TODAY TO COMPLETE.
- OVER REACTION TO TPS BONDING PROBLEMS HAVE CREATED A COMPLEX PAPER SYSTEM NOT CONDUCIVE TO EFFICIENT PROCESSING, I.E. AVG. WAD = 400-500 PAGES..
- CERTS/TRAINING HIGHLY COMPLEX = IMPRACTICAL.

DELTA: -45

TABLE 7-13.- CONTINUED

DEPARTMENT: 26-01

NAME: DIR, PAD OPERATIONS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR/STAFF	DIRECTION/ADMINISTRATION OF ENTIRE PAD OPERATIONS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-13.- CONTINUED

DEPARTMENT: 26-10/20 — NAME: MGR, PAD A/B OPS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ELECTRIC/DC POWER/HAZARDOUS GAS DETECTION SYSTEM	MAINTENANCE, CHECKOUT, CALIBRATION, SUPPORT 24 HRS, 7 DAYS, 3 SHIFTS
ENVIRONMENTAL CONTROL SYSTEM/PROVIDES AIR TO ORBITER, PCR WHITE ROOM, ETC.	OMI S0009, LAUNCH PAD VALIDATION 93 TECHS OMI S0025, HYPERGOL PROPELLANT - 80 TECHS
HYPERGOLIC SYSTEMS/MAINTAINS GSE, PIPING, VALVES	AVG NUMBER PR'S TPS'S PER MONTH = 120 PER PAD
POWER REACTANT STORAGE, FUEL CELLS/O&M OF FUEL CELLS CRYOGENIC DEWARS/DISTRIBUTION SYSTEM	AVG NUMBER OF PMOMI'S 80 PER MONTH PER PAD
SWING ARMS/HYDRAULICS FOR SWING ARMS	
LH2 SYSTEM, MAIN PROPULSION SYSTEM LO2 SYSTEM PCR & PGHM	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- TRANSFER OF FLIGHT ELEMENT PERSONNEL, ORBITER FORWARD, ORBITER AFT, ET AND SRB TO DEPT 26-30, "STATIONIZATION" REASSIGNMENTS
- INCREASED FREQUENCY AND OMRSD/MAINTENANCE DOCUMENTATION AND MAINTENANCE

DELTA: -59

TABLE 7-13.- CONTINUED

DEPARTMENT: 26-30 — NAME: MGR, MLP

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
TAIL SERVICE MAST'S / O&M OF TSM	9 PMOMI'S/MO. 20 PR'S, DR'S, TP'S PER MONTH PER MLP
DC POWER/O&M OF POWER SUPPLIES	11 PMOMI'S PER MONTH 15 PR'S, DR'S, TPS'S PER MONTH
GROUND HYDRAULICS	5 PMOMI PER MONTH 11 PR, DR, TPS PER MONTH
HAZARDOUS GAS DETECTION	13 PMOMI PER MONTH, 13 PR, DR, TPS PER MONTH
ORDNANCE	3 PMOMI/MO, 5 PR, DR, TPS/MO.
ECS	9 PMOMI/MO, 11 PR, DR, TPS/MO.
ORBITER FORWARD PERSONNEL	42 PR, DR, TPS PERFORMED PER LAUNCH CYCLE
ORBITER AFT PERSONNEL	112 PR, DR, TPS PER WORK FLOW
ET PERSONNEL	18 PR, DR, TPS PER FLOW
SRB PERSONNEL	23 PR, DR, TPS PER FLOW

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- TRANSFER OF PERSONNEL, ORBITER FORWARD, ORBITER, AFT, ET AND SRB FROM DEPT 26-10/20, STATIONIZATION REASSIGNMENTS
- INCREASED FREQUENCY AND OMRSD/MAINTENANCE DOCUMENTATION AND MAINTENANCE

DELTA: +115

TABLE 7-13.- CONCLUDED

DEPARTMENT: 27-01,10,11,12,13,20,21,22,23

NAME: OFFSITE 7 CONTINGENCY LANDINGS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
KSC - DEVELOP & MAINTAIN ALL DOCUMENTATION FOR OFFSITE LANDING SITES	REQUIRES NORMAL 5 DAY/1 SHIFT WORK WEEK AND 7 DAY 3 SHIFT CONTINUOUS DURING LANDING AND RECOVERY OPERATIONS
DRYDEN FLIGHT RESEARCH FACILITY	
WHITE SANDS SPACE HARBOR	
TRANS-OCEANIC ABORT LANDING SITES	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- INCREASED REQUIREMENTS/SAFETY/PLANNING/CERTIFICATIONS IN THIS AREA HAVE CREATED A SEPARATE DIRECTORATE/ORGANIZATION TO HANDLE THE CHANGED PROGRAM. 104 DEDICATED/TRAINED PERSONNEL ARE NOW REQUIRED TO SUPPORT THE LAUNCH/RECOVERY/OFFSITE OPERATIONS SEE 27XX C&RS ORGANIZATION CHARTS

i.e. PREVIOUSLY OFFSITE AND RECOVERY WAS PART OF OPF OPS
AND EACH LAUNCH/RECOVERY CYCLE INTERRUPTED THE OPF HB-FLOW

- INCREASED TRAINING AND CERTS REQUIRE SPECIALIZED & LONG-TERM TRAINING PROGRAMS FOR CONVOY TAL & TURNAROUND OPS.

DELTA: +78

7.8 24-XX MORTON THIOKOL

Morton Thiokol is responsible for the overall SRB/ET processing and integration with the Orbiter. ET operations include the initial receipt from the Michoud Assembly Facility and offload from the barge, checkout and complete assembly, mating to the SRB and final preparation for launch. SRB processing includes receipt from Morton Thiokol, Incorporated (MTI) WASATCH, offloading from railcar, checkout and preparation, stacking, and integration with the ET and the Orbiter. Post launch activities include SRB recovery, disassembly of the flown boosters, and their return to the manufacturers for refurbishment.

The manning levels to support this activity prior to STS 51-L averaged 452 equivalents. The projected levels for 1990 are estimated at 485 equivalents, an increase of 33. (Both numbers include 21 indirects). In September 1987, the headcount is anticipated to be 387, while growing to 420 in September 1988. Comparing the pre-STS 51-L and September 1989 levels, the major increases in manning occur in departments 24-10, Direction and Administration of Operations (+6), department 24-30, MTI Quality Assurance, Engineering and Inspection (+18) and department 24-50, SRB/ET Processing (+20).

MTI manpower is driven by the launch processing manifest and related KSC schedules. Operations are conducted on a 3-shift, 5-day basis. Prior to STS 51-L, peak overtime of 30% was experienced in most of the MTI departments. Four shift managers are being added to provide management better floor visibility, and 2 contract specialists are being added to reduce the high overtime rates. As a result of increased emphasis on quality assurance, engineering, and inspection, department 24-30 is adding manpower to handle increased work requirements and to reduce overtime constraints. SRB/ET processing increased requirements include the mechanical force/ultra sonic testing of each SRB segment, joint heater installation and checkout, and joint leaks testing and "J" seal inspection after stacking.

Although sufficient work volume indicators were provided by this department for the expected work requirements, no correlation could be made between the increase in manpower requested and pre-STS 51-L.

Figure 7-8, Morton Thiokol organizational chart is followed by Table 7-14, a bottoms-up analysis of Morton Thiokol operations and by Table 7-15, a Morton Thiokol breakdown by department.

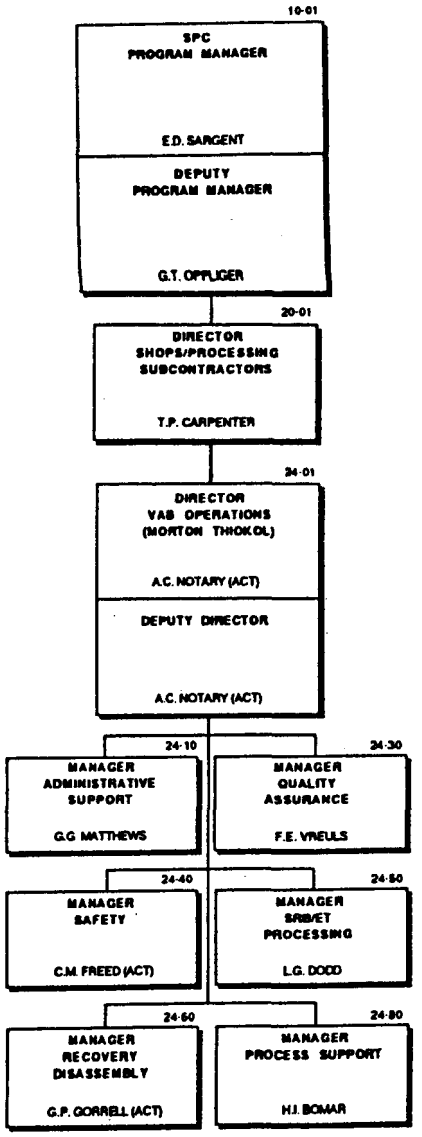

Figure 7-8.- Morton Thiokol organizational chart.

TABLE 7-14.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
MORTON THIOKOL OPS

NO.	ORGANIZATION:	PRE-51L			FY1990		DELTA	
		OVERTIME RATE	AVE HEADCOUNT	AVE EP	AVE HEADCOUNT	AVE EP	AVE HEADCOUNT	AVE EP
24-XX	MORTON THIOKOL OPS	1.13	400	450	480	485	80	34
24-01	DIR, VAB OPS - SRB				2	2	2	2
24-10	MANAGEMENT & STAFF	1.12	7	8	10	10	3	2
24-30	QUALITIY ASSURANCE	1.18	63	74	88	89	25	15
24-40	SAFETY	1.13	13	15	20	20	7	6
24-50	ET/SRB PROCESSING	1.12	203	226	224	226	21	0
24-60	SRB RETRL/DISASSEMBLY	1.12	77	86	93	94	16	8
24-80	PROCESS SUPPORT	1.12	37	41	43	43	6	2

TABLE 7-15.- MORTON THIOKOL BREAKDOWN BY DEPARTMENT

DEPARTMENT: 24-01,10

NAME: DIR, VAB OPS - SRB
MGR, ADMIN SUPPORT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR	ADMINISTRATION
VAB/RPSF OPERATIONS	DIRECTION/ADMINISTRATION
DIRECTION & ADMINISTRATION OF VAB OPERATIONS WHICH INCLUDES THE RPSF AND HANGAR AF RETRIEVAL AND DISASSEMBLY OPERATIONS	MANAGEMENT OF LOGISTICS OPERATIONS
	MANAGE ALL MTI/SPC CONTRACT FUNCTIONS INCLUDING BUDGET, FINANCIAL MANAGEMENT & HUMAN RESOURCES

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDED THREE (3) SHIFT MANAGERS - PROVIDE MTI UPPER MANAGEMENT VISIBILITY OF FLOOR OPERATIONS

ADDED TWO (2) CONTRACT SPECIALISTS TO REDUCE HIGH OVERTIME RATE PRE 51-L (30%) TO (1%)

DELTA: +5

TABLE 7-15.- CONTINUED

DEPARTMENT: 24-30

NAME: MORTON THIOKOL (QUALITY ASSURANCE)
(QUALITY ENGINEERING/QUALITY INSPECTION)

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE QUALITY INSPECTION FOR THE FOLLOWING FUNCTIONS:	NEW NDT/NDE ACTIVITIES AND PRECISION MEASUREMENTS
ET PROCESSING	INCREASED FLOOR COVERAGE REQUIREMENTS
ET/SRB STACKING BOOSTER BUILDUP ACM - RPSF	INCREASED LABORATORY TESTING/EVALUATION
ACM - VAB AF HANGAR OPERATIONS	INCREASED RECURRENCE CONTROL ACTIVITIES
RECEIVING INSPECTION MECHANICAL SHOP	INCREASED QUALITY PLANNING ACTIVITIES
SURVEILLANCE	NEW SURVEILLANCE INSPECTION REQUIREMENTS
PROVIDE QUALITY ENGINEERING FOR THE FOLLOWING FUNCTIONS:	
BOOSTER BUILDUP SUPPORT RPSF VAB PROCESSING HB 1, 2, 3, 4 QUALITY LABORATORY OPERATIONS DISASSEMBLY OPERATIONS/HGR AF NDT/NDE AND MEASUREMENTS RECURRENCE CONTROL QUALITY PLANNING	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

EP OVER PRE 51-L MANNING DUE TO INCREASED WORK SCOPE (ABOVE); (10)

OVERTIME REDUCTION AND 7/3 SHIFT REQUIREMENTS (15)

DELTA: +25

TABLE 7-15.- CONTINUED

DEPARTMENT: 24-40 — NAME: MTI SAFETY

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECT SUPPORT TO ALL PROCESSING FACILITIES (VAB, RPSF, HANGER AF, SRB RETRIEVAL ACTIVITIES)	SUPPORT OF MULTIPLE FACILITIES AND SIMULTANEOUS OPERATIONS IN SUPPORT OF STS PROCESSING
DEVELOP SAFETY REQUIREMENTS FOR PRETEST BRIEFINGS FOR HAZARDOUS OPERATIONS	
FACILITY SAFETY WALKDOWNS AND INSPECTIONS	SEVEN DAYS A WEEK; THREE SHIFTS PER WEEK
REAL-TIME REVIEW OF WORK AUTHORIZATION DOCUMENTS.	INCREASED PROCESSING FACILITIES
ESTABLISH AND MAINTAIN SAFETY CLEARANCES ASSOCIATED WITH HAZARDOUS OPERATIONS	INCREASED HAZARDOUS OPERATIONS
SUPPORT OF MISHAP INVESTIGATIONS	EXTENDED FACILITY MODIFICATION ACTIVITIES
TOXIC VAPOR CHECKS AND OTHER TYPE II ENVIRONMENTAL CHECKS	EXPANDED SRB TEST ACTIVITIES
PERFORM OPERATIONAL HAZARD ANALYSIS IN SUPPORT OF SYSTEM SAFETY ENGINEERING ACTIVITIES	
SUPPORT OF SRB RETRIEVAL ACTIVITIES	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +7

TABLE 7-15.- CONTINUED

DEPARTMENT: 24-50 — NAME: MGR, SRB/ET PROCESSING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ET/SRB PROCESSING	LAUNCH VEHICLE PROCESSING MANIFEST AND RESULTING KSC SCHEDULES, ET PROCESSING INVOLVES 85 MAJOR OPERATIONS PER TANK ON 10 HIGH BAY LEVELS, 7 COMPONENTS HANDLED
VAB/RPSF OPERATIONS	
OFFLOAD ET FROM BARGE AND PREFLIGHT CHECKOUT, OFFLOAD ET FROM BARGE, TRANSPORT TO VAB AND POSITION IN CHECKOUT CELL	RPSF PROCESSING INVOLVES 88 MAJOR OPERATIONS PER SRB CONDUCTED ON 8 LEVELS & IN 5 FACILITIES, 5000 COMPONENTS ARE HANDLED
OFFLOAD SRM SEGMENTS FROM RAILCARS AND PRESTACK ASSEMBLY	53 MAJOR OPERATIONS IN STACKING, 3 CREWS PER SHIFT TO SUPPORT THREE PARALLEL OPERATIONS. 1600 COMPONENTS ARE HANDLED. 144 MAJOR OPERATIONS IN MATE. 6660 COMPONENTS ARE HANDLED
SRB STACKING, RECEIVE & INSPECT FORWARD ASSEMBLIES ON MLP, SECURE HOLDDOWN POSTS, PIN, LEAK CHECK ETC.	GSE MAINTENANCE DRIVER BY REPEATABLE MAINT., RECALL SYSTEM, MANIFEST, EXTENSIVE COORDINATION, 970 GSE ITEMS
ET/SRB MATE AND CLOSEOUT/REMOVE ET FROM STORAGE CELL, MATE ET's TO SRBs, PERFORM FINAL ASSEMBLY & CHECKOUT	61 MAJOR OPERATIONS, 500 COMPONENTS HANDLED
GSE MAINT/MAINTAIN ET AND SRB GSE	
MLP HOLDDOWN POST REFURBISHMENT & PAD SUPPORT	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDED 3RD SHIFT IN RPSF/VAB TO SUPPORT NEW RQMTS POST 51-L AND REDUCE HIGH PRE 51-L OVERTIME RATE (21%). (+23) THESE PERSONS WILL BE CROSS-UTILIZED BETWEEN THE RPSF AND THE VAB. (-7) NEW REQUIREMENTS INCLUDE: MECHANICAL FORCE/ULTRA SONIC TEST OF EACH SRB SEGMENT; JOINT HEATER INSTALLATION AND CHECKOUT; JOINT LEAK CHECK; "J" SEAL INSPECTION AFTER STACK. (+5) FRS ADD'L RQMTS ARE IDENTIFIED, THIS NUMBER MAY INCREASE.

DELTA: +21

TABLE 7-15.- CONTINUED

DEPARTMENT: 24-60

NAME: MGR, RECOVERY DISASSEMBLY

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
RETRIEVAL & DISASSEMBLY OF THE SRB,/ OPERATE THE RETRIEVAL VESSELS, PERFORM RETRIEVAL VESSEL MODS & MAINTENANCE, GSE MODS & MAINTENANCE, DIVING EQUIPMENT, DISASSEMBLY SUPPORT, SRB DISASSEMBLY, FACILITIES GSE O & M AND EQUIPMENT MODIFICATION	MANPOWER DICTATED BY STS LAUNCH SCHEDULE AND HANGAR AF AUTOMATED PREVENTIVE MAINTENANCE SYSTEM EACH CREW SHIP MANNED 24 HRS/DAY DIVE TEAM SIZE BASED ON 10 MINUTE BOTTOM TIME DISASSEMBLY INCLUDES BREAKDOWN OF SRB's INTO 2000 SUBASSEMBLIES/COMPONENTS AND SHIPMENT TO ELEMENT CONTRACTOR/VENDOR

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

MANPOWER INCREASE DUE TO HIGH PRE 51-L OVERTIME RATE (30%)

DELTA: +16

TABLE 7-15.- CONCLUDED

DEPARTMENT: 24-80

NAME: MGR, PROCESS SUPPORT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SRB/ET PROCESS SUPPORT/ENGINEERING SUPT FOR GSE SITE MANAGEMENT ENHANCEMENT STUDIES/SPECIAL STUDIES & ANALYSIS & COMPUTER DATA STORAGE, INTERNAL AUDITS	MAINTAIN 968 ITEMS OF GSE ET & SRB ISSUE ALL SRB & ET GSE PAPER, DISPOSITION MR's & DR's MICR PREPARATION & FILE MAINTENANCE (OM, OMI, SPI, DWGS, SPECS, ETC) COORDINATE NEEDS OF ALL VAB TENANTS PARTICIPATE IN IERB

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- O INCREASED WORKLOAD DESCRIBED ABOVE (2)
- O OVERTIME REDUCTION (12%) TO (1%) (4)

DELTA: 6

7.9 3X-XX SUPPORT OPERATIONS

Support Operations, shown in Figure 7-9, provides the technical support to the facilities and the equipment required for processing operations, except for the LCC, and manages all communications systems for KSC, including new communications systems design (e.g., the Operational Intercommunications System-D (OIS-D) project). The communications system design function is new to SPC, having been transferred from PRC and the BOC/EG&G. The facilities support group includes the technicians manning the shops and labs, the crane/door/platform operators, and the O&M personnel for the structures and heavy equipment, electrical systems, pneumatics, water systems, etc.

Prior to STS 51-L, the Support Operations organization was experiencing high levels (15% composite) of overtime due to not having sufficient on-site personnel to support third shift and weekend processing operations. Technicians had to be called in when the GSE broke down and disrupted processing operations on these shifts. The shops and labs were working on 5/2 shifts during this period. The facilities O&M department had an average staffing of 672, but the equivalent manpower level when overtime was factored in was 801. The plan For FY 1990 of 853 (headcount) addresses the need to eliminate the excessive overtime by staffing (odd work - week approach) for 7/3 operations, to improve corrosion control of pad structures, and to meet additional OMRSD requirements.

The increase in the communications department from pre-STS 51-L levels is significant, even when overtime is factored in. Before STS 51-L, the 317 personnel averaged 9 percent overtime - an equivalent level of 344. The growth to 396 personnel, assuming 1 percent overtime, was justified on several accounts: the need to provide voice, wideband TV, and cable O&M on a 7/3 schedule, the addition of navigation aids support for the new contingency landing sites (+5), and the need for concurrent support to the new OIS-D system (+26) and the existing 20-year-old equipment. Discussions with KSC personnel responsible for this area indicated that the 1 percent overtime guideline was responsible for increasing staffing levels from what was considered appropriate to a more reasonable (5 percent) guideline.

7.9.1 Grumman Technical Services

Grumman Technical Services, Inc. (GTSI) conducts the operations and maintenance of the launch processing systems. This includes the CCMS equipment sets, the record and playback system (RPS), and the central data subsystem (CDS). GTSI is also responsible for the instrumentation, calibration, and measurement of a multitude of systems. The manning levels prior to STS 51-L averaged about 729 equivalents; the projected levels for 1990 are estimated at 752 equivalents. The Shuttle Operations direct equivalents is 627, due to the DOD paying for the support to secure systems. In September 1987, the headcount level is anticipated to be 600, and it increases to 675 in September 1988.

Comparing the pre-STS 51-L and September 1989 manpower levels, the major increases in manning reside in LPS operations, instrumentation, calibration and engineering support. LPS operations manpower increases include support for additional SPDMS hardware, LTTS development, CCMS upgrades, and increased DOD and OMRSD processing requirements. The contractor previously underestimated the increased instrumentation workloads resulting from STS 51-L related changes. Increased requirements based on OMRSD and OMI reviews and the MLP-3 early reactivation requires 500 additional calibrations.

Table 7-16 is a bottoms-up analysis of support operations and Grumman/LPS. Table 7-17 is a Support Operations breakdown by department.

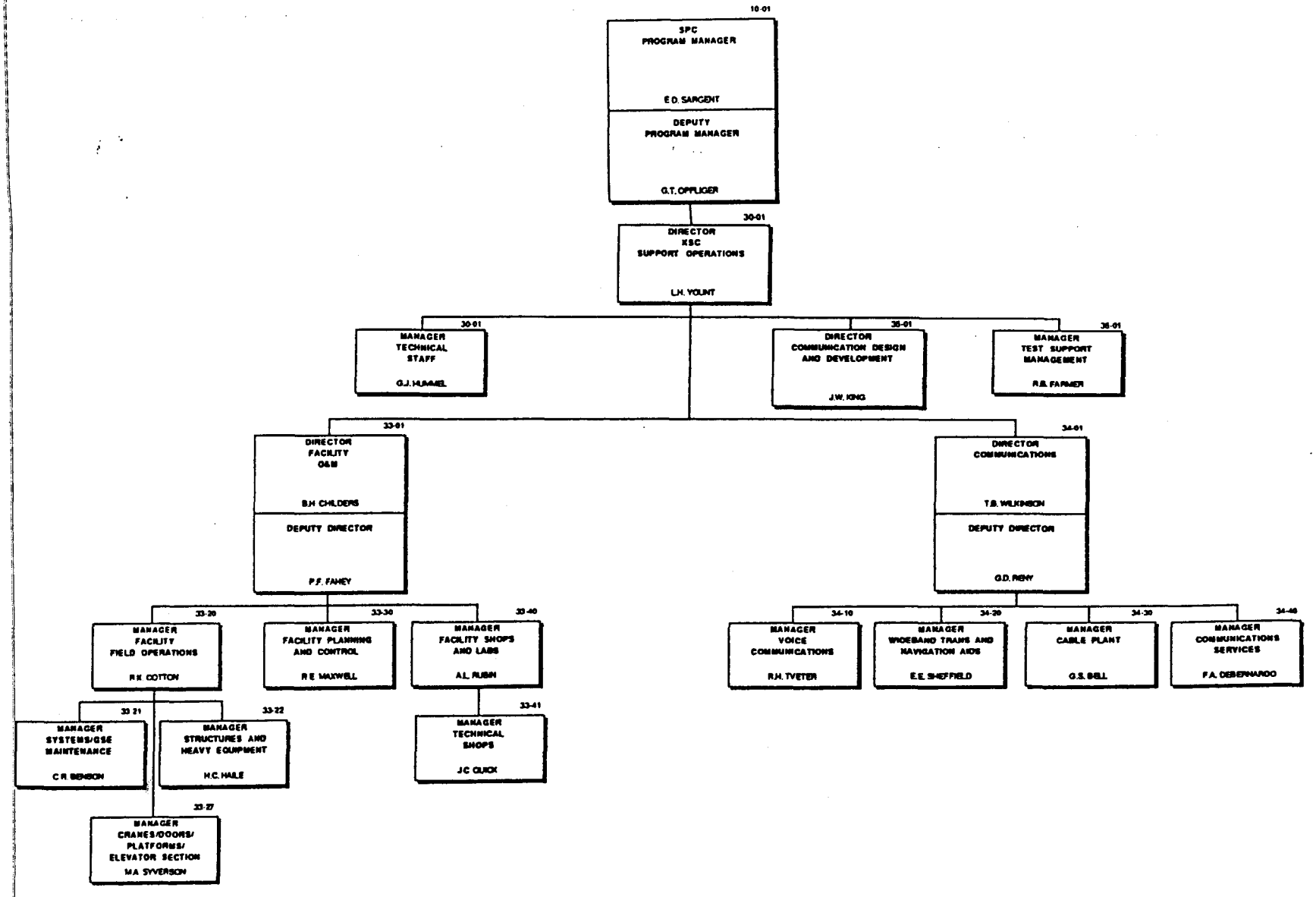

Figure 7-9.- Support Operations organizational chart.

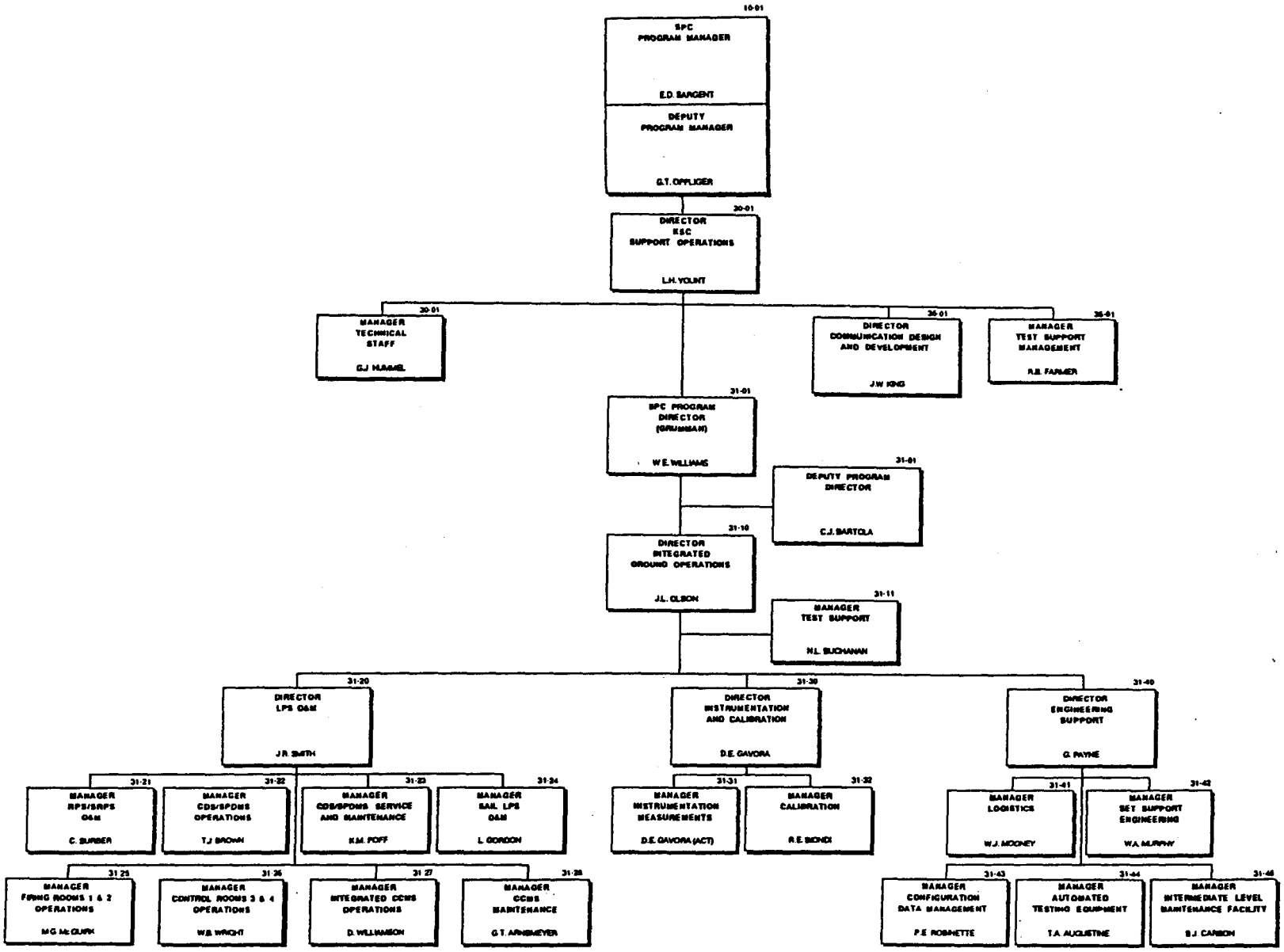

Figure 7-9.- Concluded.

TABLE 7-16.

(A) SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
SUPPORT OPERATIONS

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
3X-XX	SUPPORT OPERATIONS	1.15	1060	1220	1335	1348	275	128
30-01	DIRECTOR		11	11	11	11	0	0
33-XX	FACILITIES O & M	1.19	672	801	853	862	181	60
33-01	Manager & Staff		7	7	12	12	5	5
33-10	Resources Administration		14	15	17	17	3	2
33-2X	Field Operations		426	510	541	546	115	36
33-3X	Planning & Control		91	109	108	109	17	0
33-4X	Shops & Labs		134	160	175	177	41	17
33-2X	Facility Field Ops	1.20	426	510	541	546	115	35
33-20	Manager & CCC Ops	1.20	15	18	30	30	15	12
33-21	System/GSE Maint		143	172	203	205	60	33
33-22	Structures/Heavy Equip		173	208	200	202	27	-6
33-27	Cranes/Doors/Elev/Platfm		95	114	108	109	13	-5
33-21	System/GSE Maint	1.20	143	171	203	205	60	34
33-21	Manager		6	7	7	7	1	0
33-23	Electrical		63	75	97	98	34	23
33-24	Pneumatics		29	35	38	38	9	4
33-25	HVAC/ECS Group		45	54	61	62	16	8
33-22	Structures/Heavy Equip	1.20	173	207	200	202	27	-4
33-22	Manager		5	6	7	7	2	1
33-28	Water Systems		38	45	53	54	15	9
33-29	Heavy Equipment		78	93	80	81	2	-12
33-2A	Structures		52	62	60	61	8	-2
33-27	Cranes/Doors/Elev/Platfm	1.20	95	114	108	109	13	-5
33-3X	Planning and Control	1.20	91	109	108	109	17	0
33-30	Manager		4	5	3	3	-1	-2
33-33	Work Control		36	43	46	46	10	3
33-34	Planning/Scheduling		26	31	28	28	2	-3
33-35	Modification Mgmt		25	30	31	31	6	1

TABLE 7-16.- CONTINUED

(A) CONTINUED

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
33-4X	Shops & Labs	1.20	134	160	175	177	41	16
33-40	Manager		8	10	9	9	1	-1
33-41	Technical Shops		126	151	166	168	40	16
34-XX	COMMUNICATIONS	1.09	317	344	368	372	51	27
34-01	Department		4	4	3	3	-1	-1
34-10	Voice		126	137	143	144	17	7
34-20	WB/TV & Nav Aids		98	106	129	130	31	24
34-30	Cable		54	59	55	56	1	-3
34-40	Comm Serv		35	38	38	38	3	0
35-XX	COMMUNICATIONS DESIGN	1.04	25	26	56	57	31	31
35-01	Director		0	0	2	2	2	2
35-11	Communications Design		0	0	19	19	19	19
35-12	OIS-D Project		0	0	14	14	14	14
35-13	Electronic Dev Lab		25	26	21	21	-4	-5
36-XX	TEST SUPPORT MGMT OFC	1.07	35	37	47	47	12	10

(B) SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
GRUMMAN/LPS

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 PROJ'D HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
31-XX	ORGANIZATIONAL TOTAL	1.04	702	729	745	752	43	23
31-00	BUSINESS OPS		37	37	30	30	-7	-7
31-1X	TEST SPT SPECIAL PROJECTS		45	47	43	43	-2	-4
31-11	Test Support		32	33	33	33	1	0
31-12	Special Projects		13	14	10	10	-3	-4
31-2X	LPS O&M		313	326	334	337	21	12
31-21	RPS O&M		58	60	74	75	16	14
31-22	CDS Operations		110	114	115	116	5	2
31-23	CCMS O&M		145	151	145	146	0	-4

TABLE 7-16.- CONCLUDED

(B) CONTINUED

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 PROJ'D HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
31-3X	INSTRUMENTATION CAL		99	103	132	133	33	30
31-31	Instrumentation		64	67	86	87	22	20
31-32	Calibration		35	36	46	46	11	10
31-4X	ENGINEERING SPT		208	216	206	208	-2	-8
31-40	Engr. Director		3	3	4	4	1	1
31-41	Logistics		47	49	45	45	-2	-3
31-42	Engr. Support		40	42	44	44	4	3
31-43	Conf. Mgt		48	50	39	39	-9	-11
31-44	ATE/Test Tools		15	16	19	19	4	4
31-45	Shops/Labs		55	57	55	56	0	-2

TABLE 7-17.- SUPPORT OPERATIONS BREAKDOWN BY DEPARTMENT

DEPARTMENT: 30-01 NAME: DIR, KSC SUPPORT OPS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR, SUPPORT OPERATIONS - KSC	MANAGEMENT/ADMINISTRATIVE
OVERALL MANAGEMENT OF THE OPERATION AND MAINTENANCE OF THE STS KSC PROCESSING FACILITIES, FACILITY SYSTEMS, GROUND SUPPORT SYSTEMS & EQUIPMENT, INCLUDING SUPPORTING SHOPS AND LABS	
TECHNICAL STAFF	
MANAGEMENT SUPPORT STAFF	TECHNICAL INTEGRATION SITE ACTIVATION PERSONNEL BUDGET

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: 0

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-01, 10 NAME: DIR, FACILITY O&M RESOURCES ADMIN

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR/STAFF RESOURCES ADMIN	INCREASED MANAGEMENT VISABILITY OF DIRECTORATE ACTIVITIES & RESOURCE ANALYSIS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

AN INCREASE IN UPPER MANAGEMENT VISABILITY IS REQUIRED ON ALL OFF SHIFTS (SHIFT 2/3) (5).
AN INCREASE IS REQUIRED TO PROVIDE THE MANNING TO COVER THE ADDITIONAL MOVE ACTIVITY DUE TO THE BUILDUP (2)
INCREASE OF AUDITS, PERSONNEL, AND ADMINISTRATIVE AND PLANNING TASK (1)

DELTA: 8

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-20	NAME: MGR, FACILITY FIELD OPS & CCC OPS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
FACILITY FIELD OPERATIONS	365 DATA/YR REMOTE MONITORING
CCC OPERATIONS GROUP	9,248 SYSTEMS DATA POINTS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASE CONSOLE MANNING TO 7/3 TO PROVIDE BETTER MONITORING TO REDUCE PRE 51-L OVERTIME RUNNING (15)

DELTA: +15

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-21,23,24,25	NAME: MGR, SYSTEMS/GSE MAINTENANCE
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
SYSTEMS/GSE EQUIPMENT	
ELECTRICAL GROUP	143 UNIT SUBSTATIONS 31 UNIT 4132 KVA 7 AUTOMATED STORAGE RETRIEVAL SYSTEMS
PNEUMATIC GROUP	196 STORAGE VESSELS 36 COMPRESSORS 17 SYSTEMS
HVAC/ECS GROUP	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

PREVENTIVE MAINTENANCE, TECHNICAL DEVELOPMENTS, PREPARATION OF TECHNICAL ACTIVITIES STATUS REPORTS, LONG-RANGE PLANNING (2)
ADDED FACILITIES AND SYSTEMS, PRESSURE VESSEL RECERTIFICATION, ADDITIONAL LANDING SITES, OVERTIME RUNNING 10 TO 51% WEEKLY, AND OVERTIME LIMITATIONS (58)

DELTA: +60

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-22, 28, 29, 2A

NAME: MGR, STRUCTURES & HEAVY EQUIPMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
WATER SYSTEMS GROUP	
SOUND SUPPRESSION	3 MLPs, PADS A & B
FIREX SYSTEMS	22 PUMPS
PADS A & B, OPF, OMRF, VAB, MOD, RPSF, HMF, 3 MLPs	14 MOTORS 8 DIESELS
HEAVY EQUIPMENT	342 PIECES 4 MOBILE CRANES 9 AERIAL PLATFORMS 5 AIRCRAFT TUGS 1 CONVOY VAN
STRUCTURES	
ROTATING SERVICE STRUCTURE (RSS)	28 MOVABLE PLATFORMS
FIXED SERVICE STRUCTURE	2 MOVABLE PLATFORMS
MLP	52 COMPARTMENT DOORS PER MLP
FLAME DEFLECTORS	7 DIESEL ENGINES
CRAWLERS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

LONG-RANGE PLANNING, FOCS ADP SYSTEM ADMINISTRATION, ADDITIONAL AUDITS, AND ADDITIONAL PREVENTIVE MAINTENANCE COORDINATION (2)
ADDED SYSTEMS AND HEAVY EQUIPMENT SUPPORT, OVERTIME RUNNING 7 TO 71% WEEKLY, OVERTIME LIMITATIONS AND 7/3 COVERAGE (25)
INTERNAL REDISTRIBUTION OF STAFF PERSONNEL

DELTA: +27

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-27

NAME: MGR, CRANES/DOORS/PLATFRMS/ELEVATORS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
CRANES/DOORS/PLATFORMS/ELEVATORS	115 DEVICES FROM 1 TO 250-TON CAPACITY
MATE/DEMATE DEVICES AT KSC AND DFRF	
VAB & RPFS WORK PLATFORMS	462 PLATFORMS, 236 POWER OPERATED
OPF ORBITER FLOOR LIFTS	
ELEVATORS	38 ELEVATORS FROM 3 FLOOR OFFICE ELEVATOR TO VAB & PAD

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDITIONAL FACILITY, MAINTENANCE AND REDUCTION OF OVERTIME (4.7% TO 50.4% WEEKLY) AND 7/3 COVERAGE (11)
ADDITIONAL ENGINEERING TO COVER CLOSED LOOP MAINTENANCE SYSTEEM AND 7/3 COVERAGE (2)

DELTA: +13

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-30, 33, 34, 35

NAME: MGR, FACILITY PLANNING & CONTROL
MGR, WORK CONTROL
MGR, PLANNING & SCHEDULING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
FACILITY PLANNING & CONTROL	2-SHIFT/7-DAY SUPPORT REQUIRED
WORK CONTROL/DOCUMENT GENERATION, SCHEDULING AND STATUSING	SHOP SCHEDULES AND SPECIAL REPORTS
SCHEDULING & PLANNING/PROVIDE UMD SUPPORT TO AND STATUSING	PREPARE AND MAINTAIN 500 OMIs AND 10MMs
OPERATE REAL TIME SUPPORT AND TROUBLE CALL SERVICE	943 REAL TIME REQUESTS 717 TROUBLE CALLS/MO 188 OUTAGES/MO
MODIFICATION MANAGEMENT PREPARE LAUNCH EQUIPMENT SHOP (LES)	90 MANDATORY RTFS MODS CONTINUOUS PLANNING FOR CORROSION CONTROL 188 OUTAGES/MO
MODIFICATION MANAGEMENT PREPARE LAUNCH EQUIPMENT SHOP (LES) WORK PACKAGES	90 MANDATORY RTFS MODS CONTINUOUS PLANNING FOR CORROSION CONTROL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

1ST AND 2ND SHIFT AND ODD WORK WEEK (OWW) COVERAGE. OVERTIME WAS AT 3 TO 26% PER WEEK VS NEW OVERTIME LIMITATIONS (10)
ADDITIONAL OMRSD REQUIREMENTS AND SHOP ENGINEERING WORK LOAD (7)

DELTA: +17

TABLE 7-17.- CONTINUED

DEPARTMENT: 33-40,41

NAME: MGR, FACILITY SHOPS & LAB
MGR, TECHNICAL SHOPS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
FACILITY SHOPS & LABS PROVIDES OVERALL DIRECTION OF THE TECHNICAL SHOPS AND LABS	MANAGEMENT DIRECTION
TECHNICAL SHOPS MECHANICAL SHOPS/MECHANICAL FABRICATION, CORROSION CONTROL, MINOR MOVES AND PAINTING	FABRICATION, MODIFICATION, REFURBISHMENT REPAIR AND MAINTENANCE OF C/T'S, MLP'S, PADS, OPF, VAB AND OTHER LC-39 FACILITIES, SYSTEMS, AND EQUIPMENT
ELECTRICAL/ELECTRONIC - ELECTRICAL FABRICATION, CABLE POTTING AND MOLDING, PRINTED CIRCUIT BOARD FABRICATION	FABRICATION, MODIFICATION, INSTALLATION, REPAIR AND MAINTENANCE OF LC-39 ELECTRICAL SYSTEMS, EQUIPMENT ASSEMBLY AND TESTING OF PRINTED CIRCUIT BOARDS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

SHOP BACKLOG TOO HIGH (12) GET TO 2-4 WEEK BACKLOG (MORE THAN 4 WEEKS IMPACTS USERS)
5X2 SHIFT SUPPORT NOT SUFFICIENT TO PROVIDE ADEQUATE SUPPORT TO USERS: 7/3 (31)
PRE 51-L OVERTIME RUNNING 10 TO 50% PER WEEK
CORROSION CONTROL SHOP NOT MANNED SUFFICIENTLY TO PROPERLY MAINTAIN PAD STRUCTURES (10)

DELTA: +41

TABLE 7-17.- CONTINUED

DEPARTMENT: 34-01,10,20,30,40

NAME: DIR COMMUNICATIONS
MGR VOICE COMMUNICATIONS
MGR, WIDEBAND TRANS & NAVAIDS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECTOR, COMMUNICATIONS	ADMINISTRATIVE
VOICE SYSTEMS/OPERATE AND MAINTAIN ALL OPERATIONAL VOICE SYSTEMS, SECURE COMMUNICATIONS, SUSTAINING ENGINEERING FOR ALL SYSTEMS	2676 OIS UNITS 4112 SPECIAL AUDIO EQUIPMENT UNITS 51 PAGING & AREA WARNING SYSTEMS 500 MOBILE, 800 PORTABLE, 40 FIXED STATIONS
WIDEBAND TRANSMISSION/O&M OF COLOR TELEVISION SYSTEMS, O&M OF DATA TRANSMISSION DISTRIBUTION AND SWITCHING SYSTEMS, SUSTAINING ENGINEERING	DRYDEN SLA-OIS, RADIO, AUDIO, RECORDING, PAGING, AND WARNING
NAV-AIDS/O&M OF CABLE SYSTEMS, O&M AND LANDING SITE	
CABLE SYSTEMS/O&M OF CABLE SYSTEMS, O&M TELEPHONE EQUIPMENT & MAINFRAMES - PROVIDE SUSTAINING ENG	1.5 BILLION CONDUCTOR FT. 90 MAIN DISTRIBUTION FRAMES, 900 TELEPHONE CABINETS 40 MILES OF MULTI-STRAND FIBER OPTICS CABLE, 20 TERMINAL LOCATIONS, 400 MANHOLES AND 48 MILES OF DUCT BANK

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADMINISTRATIVE (-1)
WIDEBAND TRANSMISSION - INCREASE FOR 7/3 SHIFTS (3), INCREASED DATA SUPT (9), INCREASED COLOR TV (3)
NAV-AIDS - ADD'L CLS SUPPORT (4)
CABLE SYSTEMS - INCREASE FOR 7/3 SHIFTS (3), ADD'L FIBER OPTICS (2)
COMMUNICATIONS - INCREASE FOR 7/3 SHIFTS (5), ADD'L SOFTWARE (2), ADD'L PLANNING (2)
VOICE COMM - INCREASE FOR 7/3's (9), INCREASED VOICE EQUIPMENT (10)

DELTA: +51

TABLE 7-17.- CONTINUED

DEPARTMENT: 35-01,11,12,13

NAME: MGR, COMM DESIGN & DEVELOPMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
COMUNICATIONS DESIGN OF NEW COMMUNICATION ELEMENTS OR SYSTEMS/INCLUDING PHOTO OPTICS TIMING AND COUNTDOWN, VIDEO SYSTEMS, FIBER OPTICS AREA PAGE AND WWARNING, SECURE COMMUNICATIONS, VOICE COMUNICATIONS	DEVELOP/REVISE MULTI-YEAR COMMUNICATIONS MODERNIZATION PLAN PERFORM DESIGN STUDIES AND DEVELOP CANDIDATE DESIGN CONCEPTS
DESIGN SUPPORT TO DE FOR DEVELOOPMENT OF THE OIS-D	DESIGN AND FOLLOW THROUGH OF END INSTRUMENTS DEVELOP TEST PROCEDURES, SOFTWARE REQUIREMENTS GENERATE 30,600 LINES OF CODE 100 PC BOARD LAYOUT 600 DRAWING SHEETS
ELECTRONIC DEVELOPMENT LAB/PROVIDE FACILITY EXPERTISE FOR PROTYPING HARDWARE AS WELL AS FOR FABRICATING UNIQUE PRODUCTION HARDWARE	PROTOTYPE WORK IN-HOUSE 5,000 M/HRS, PRODUCTION 19,000 M/HRS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ORGANIZATION WAS NOT IN EXISTENCE PRIOR TO 51-L

0 DE DIDN'T GIVE THEM GOOD STATEMENTS OF WORK ON WHAT WAS EXPECTED WHEN WORK WAS TRANSFERRED TO LSOC

0 TRANSFERRED FUNCTIONS FROM 4 DE CONTRACTORS (PRC, BOEING, TWO OTHERS) - 80-90

DELTA: +31

TABLE 7-17.- CONTINUED

DEPARTMENT: 36-01

NAME: MGR, TEST SUPPORT MGT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
TEST SUPPORT MANAGEMENT/IMPLEMENTS THE LSOC SUPPORT OPERATIONS TEST DIRECTOR FUNCTION	PROVIDE MANAGERIAL LEADERSHIP
MANAGE TEST TEAM WHO SUPPORT ALL FLIGHT ELEMENT INTEGRATED TESTING THROUGH LAUNCH PROCESSING	MANPOWER FOR 2 FIRING ROOMS, 2 MEN PER CONSOLE 7 DAYS/3 SHIFTS 400 O&M DOCUMENTS DAILY MEETINGS COORDINATING/INTEGRATING RESOURCES
TEST SUPPORT OPERATIONS	MAIN DRIVER BEHIND "KICS" SCHEDULE
SUPPORT OPERATIONS DUTY OFFICERS	COORDINATE REALTIME RQUESTS & SCHEDULE CHANGES
SUPPORT OPERATIONS SITE MANAGEMENT	COORDINATION OF SUPPORT OPERATIONS
TEST SUPPORT PLANNING	DEVELOPMENT OF TECHNICAL DOCUMENTATION
SPECIAL REPORTS	ATTENDING NUMEROUS MEETINGS AND PREPARATION OF MANAGEMENT REPORTS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- 0 OVERTIME REDUCTION AND LIMITS ON HOURS & CONSECUTVE WORK DAYS (9)
- 0 INCREASED REPORTING REQUIREMENTS AND MANAGEMENT REVIEWS (3)

DELTA: +12

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-01

NAME: SPC PROGRAM DIRECTOR

FUNCTION/TASK		MANPOWER DRIVER (SKILLS)	
DIRECTOR		BUSINESS MANAGEMENT	
31-00 BUSINESS OPERATIONS	PRE-51-L 37	PROJECTED 1990 30	Δ -7

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

7 PEOPLE TRANSFER TO THE MANAGEMENT ALLOCATION POOL FROM THE PRE-51-L HEADCOUNT FOR A TOTAL HEADCOUNT OF 30 IN 1990.

DELTA: -7

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-10,11,12

NAME: DIR, INTEGRATED GROUND OPS
MGR, TEST SUPPORT
MGR, SPECIAL PROJECTS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
TEST SUPPORT & SPECIAL PROJECTS	TEST SUPPORT COVERAGE IN JAN 1986 WAS INADEQUATE INTEGRATED OMI REVIEW WAS LIMITED OPEN ITEMS REVIEW WILL INCREAS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -2

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-20,21,22,23

NAME: DIR LPS O&M
MGR, RPS/SRPS OPERATIONS
MGR, CDS OPERATIONS
DEP. DIR, CCMS OPERATINS & MAINT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
LPS OPERATIONS & MAINTENANCE OPERATES AND MAINTAINS ALL CCMS EQUIPMENT SETS	50 CCMS CONSOLES 160 COMPUTER SYSTEMS CITE TESTING SAIL TESTING COMPLEX CONTROL CENTER
OPERATES & MAINTAINS THE RECORD AND PLAYBACK SUBSYSTEM (RPS)	5 COMPUTER SYSTEMS 42 ANALOG RECORDERS 40 STRIPCHART RECORDERS 40 DECOMMUTATORS SEVERAL HUNDRED TELEMETRY MODULES
OPERATES THE CENTRAL DATA SUBSYSTEM	14 LARGE SCALE COMPUTERS I/O CENTER FOR 1400 USERS AND USER ASSISTANCE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

+16 RESULTING FROM RPS EXPANSION

+5 RESULTING FROM SPDMS EXPANSION

DELTA: +21

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-30,31,32

NAME: DIR, INSTRUMEN & CALIB
MGR, INSTRUMENTATION MEASUREMENTS
MGR, CALIBRATION

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
O&M OF MEASUREMENT SYSTEMS AND LAUNCH PADS, MLP AND LCC	300 CHANNEL SYSTEM EACH PAD 100 CHANNEL SYSTEM EACH MLP 100 METEORLOGICAL TRANSDUCERS
O&M LIGHTNING WARNING AND DETECTION EQUIPMENT	29 FIELD MILL SITES, INDUCED VOLTAGE MEASUREMENT SYSTEM
INSTRUMENT CALIBRATION, REPAIR AND CLEANING	1,100 FIELD CALS/MO. 11,600 BACKLOG
OPERATES WAVE ANALYSIS LAB	700/MO COMPUTER PROCESSED RECORDS 6/MO ANALOG MAGNETIC TAPES 6/MO DIGITAL MAG TAPES 4,000 FT PER MO. OSC RECORD 20/MO 8-INCH MAG. DISC

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: +33

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-40

NAME: IGO ENGINEERING SUPPORT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
IGO ENGINEERING DIRECTOR AND STAFF RESPONSIBLE FOR DIRECTION OF FIVE (5) EPARTMENTS PROVIDING ON-LINE AND AUXILIARY SUPPORT TO LPS O&M	PROVIDE LOGISTICS, ATE, ENGINEERING SET SUPPORT, OMD AND INTERMEDIATE LEVEL MAINTENANCE SUPPORT TO EIGHT (8) CCMS STATIONS AND RPS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

(+1) STAFF ENGINEER TO PROVIDE PROJECT DIRECTION ON RETURN-TO-FLIGHT TASK, i.e., HARDWARE INVESTIGATIONS, MODIFICATIONS, MAINTENANCE PROCEDURES.

DELTA: +1

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-41

NAME: MGR, LOGISTICS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
LOGISTICS ENGINEERING SUPPORT FOR LPS HARDWARE; SPARES EVALUATION FOR NEW SYSTEMS; SUPPORT TO LPS HARDWARE MODS	PROVIDES ON-GOING SUPPORT TO EXISTING SYSTEMS NEW PRODUCT DEVELOPMENT AND MODIFICATIONS/ UPGRADE OF EXISTING HARDWARE IN THE LPS
SUPPORT THE INTERMEDIATE LEVEL MAINTENANCE FACILITY (ILMF) FOR REPAIR OF LPS LURS	10,000 LPS LRUS IN SYSTEM 400 LRUs REPAIRED/MO
MAINTAIN SUPPLY SUPPORT FACILITIES FOR ALL LPS HARDWARE	PROVIDES SUPPLY SUPPORT OF LPS LURs TO EIGHT (8) CCMS STATIONS AND RPS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ORGANIZATIONAL REALIGNMENT DELTA: -2

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-42

NAME: MGR, SET SUPPORT ENGINEERING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE FIRST LEVEL OF SYSTEM ENGINEERING SUPPORT TO LPS HARDWARE, SOFTWARE AND OPERATIONAL ANOMALIES DURING SUPPORT OF SHUTTLE TEST AND LCD	PROVIDE ON-SET SUPPORT TO MULTI-SHIFT OPERATIONS ON EIGHT (8) CCMS STATIONS
PROVIDE SECOND LEVEL HARDWARE ENGINEERING SUPPORT TO RESOLUTION OF LPS ANOMALIES	PROVIDE MULTI-SHIFT COVERAGE TO EIGHT (8) CCMS STATIONS. ENGINEERING SUPPORT IN JANUARY 1986 WAS INADEQUATE
PROVIDE ENGINEERING SUPPORT TO SUSTAINING ENGINEERING ON ALL SOFTWARE AND HARDWARE MODIFICATIONS/SURVIVABILITY PROJECTS ON LPS SYSTEMS	PROVIDE SUPPORT TO ALL HARDWARE AND SOFTWARE MODIFICATIONS TO INCLUDE RETURN-TO-FLIGHT MODS AND SURVIVABILITY TASKS ON THE LPS SYSTEMS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

HARDWARE ENGINEERING SUPPORT TO CCMS STATIONS IN JANUARY 1986 WAS INADEQUATE TO PROVIDE MANDATORY 3X7 TEST SUPPORT COVERAGE

DELTA: +4

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-43

NAME: MGR, DATA MANAGEMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE TECHNICAL SUPPORT TO NEW OR REVISED OMD/OMI DOCUMENTATION REQUIRED TO SUPPORT OPERATIONS AND MAINTENANCE OF THE LPS	MAINTAIN ALL EXISTING PROCEDURES AND IMPLEMENT NEW PROCEDURES TO SATISFY OMRSD AND RETURN TO FLIGHT REQUIREMENTS. (APPROXIMATELY 128 OMIs USED TO SUPPORT IGO O&M AND INST/CAL REQUIREMENTS)
PROVIDE OPERATIONS AND MAINTENANCE OF MAGNETIC TAPE PROCESSING AND STORAGE IN SUPPORT OF THE LPS	PROCESS, CERTIFY AND CONTROL APPROXIMATELY 33,000 MAGNETIC TAPES USED IN THE LPS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA MANPOWER RESULTS FROM REASSIGNMENT OF IGO CONFIGURATION CONTROL PERSONNEL TO OPERATIONAL ORGANIZATIONS

DELTA: -9

TABLE 7-17.- CONTINUED

DEPARTMENT: 31-44

NAME: MGR, ATE/TEST TOOL DEVELOPMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
AUTOMATIC TEST EQUIPMENT SOFTWARE DEVELOPMENT FOR LPS LRU REPAIR	600 CANDIDATE LRU PROGRAMS IN QUEUE 140 CANDIDATE LRU PROGRAMS IN PROCESS 3-6 MONTHS/PROGRAM DEVELOPMENT PER LRU
DEVELOPMENT OF SPECIAL TEST TOOLS/SYSTEMS FOR OFF-LINE AND ON-LINE MAINTENANCE OF LPS HARDWARE	O EIGHT (8) NEW TEST TOOLS IN DEVELOPMENT O FIVE (5) TEST TOOLS IN WORK O NEW TEST TOOL DEVELOPMENT IS ONGOING TO FACILITATE NEW HARDWARE AND NEW INNOVATIONS TO MAINTENANCE SUPPORT ON LPS HARDWARE

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

(+4) ENGINEERS ASSIGNED TO ENHANCEMENT AND DEVELOPMENT OF ON-LINE HARDWARE MONITOR SYSTEMS TO SUPPORT LPS OPERATIONS AND DEVELOP/IMPLEMENT NEW TEST TOOLS.

DELTA: +4

TABLE 7-17.- CONCLUDED

DEPARTMENT: 31-45

NAME: MGR, LABS & OEM

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
TEST, VALIDATION AND REPAIR OF ALL LINE REPLACEABLE UNITS (LRUs) USED TO SUPPORT MAINTENANCE OF LPS HARDWARE	0 PROCESS, REPAIR AND RETURN TO SERCICEABLE CONDITION APPROXIMATELY 400 LRUs PER MONTH
MODIFICATION, TEST AND VALIDATION OF NEW AND INSTALLED LRUs IN SUPPORT OF LPS MAINTENANCE	0 MODIFY TEST AND/OR VALIDATE APPROXIMATELY 60 NEW SPARE LRUs/MONTH
	0 MODIFY TEST AND VALIDATE LRU SPARES PER ENGINEERING WAD
TEST, VALIDATION AND REPAIR OF 'HOT SPARE' PERIPHERAL SUBSYSTEMS FOR THE LPS	0 PROVIDE 'HOT' SPARES TO EIGHT (8) CCMS STATIONS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

NO IMPACT

DELTA: 0

7.10 40-XX LOGISTICS

The logistics organization, shown in Figure 7-10, is responsible for supporting the sparing requirements of ground and flight hardware systems, meeting SPC transportation needs, and conducting the technical training of the SPC and NASA employees. Even though 32 additional personnel had to be hired to perform the logistics management responsibility for all development center/contractor GSE (as a result of a responsibility transfer to the SPC from PRC), and although the technical training area has been doubled in manpower (from 27 to 56), a comparison of the two reference periods shows a drop of 85 in equivalent manpower (553 vs. 638) and 33 in headcount (548 vs. 581).

This reduction was attributed largely to the savings based on increased automation (realized and projected) and consolidation of parts inventory from 16 sites to the new facility. Other contributors to the reduction include the elimination of Vandenberg procurement support, the use of bulk purchases, and paperwork flowtime reductions by changing the NASA contracting officer approval dollar threshold to $100 thousand from the previous $25 thousand level.

A manpower bottoms-up analysis of logistics is shown in Table 7-18. Table 7-19 details a Logistics breakdown by department.

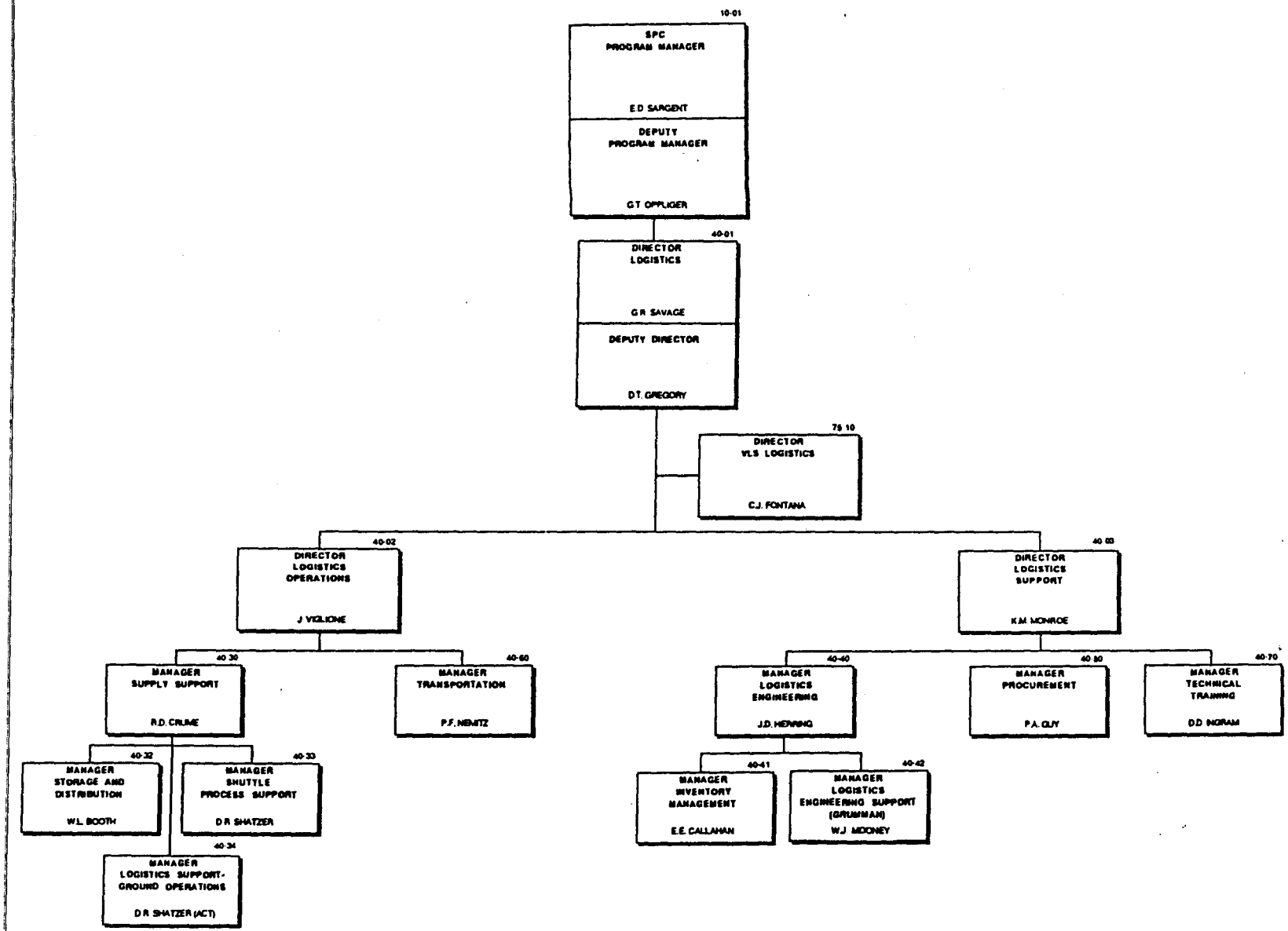

Figure 7-10.- Logistics organizational chart.

TABLE 7-18.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
LOGISTICS

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
40-XX	LOGISTICS	1.10	581	638	548	553	-33	-84
40-0X	DIR, LOGISTICS	1.04	41	42	21	21	-20	-21
40-01	DIR, LOGISTICS		4	4	15	15	11	11
40-02	LOGISTICS OPERATIONS		0	0	2	2	2	2
40-03	LOGISTICS SUPPORT		2	2	4	4	2	2
40-10	PLANS, SYS & AUDITS		35	36	0	0	-35	-36
40-3X	SUPPLY SUPPORT	1.13	298	336	237	239	-61	-96
40-30	Mgr, Supply Support		7	8	8	8	1	0
40-31	Inventory Management		56	63	0	0	-56	-63
40-32	Storage & Distribution		102	115	91	92	-11	-23
40-33	Shuttle Process Support		105	118	112	113	7	-5
40-34	Logs Spt, Ground Ops		28	32	26	26	-2	-5
40-4X	LOGISTICS ENGINEERING	1.04	85	88	131	132	46	44
40-40	Mgr, Logs Engineering		3	3	4	4	1	1
40-41	Inventory Mgt		43	45	67	68	24	23
40-42	Logistics Eng Supt		39	41	60	61	21	20
40-50	PROCUREMENT	1.10	65	72	51	52	-14	-20
40-60	TRANSPORTATION	1.10	65	72	52	53	-13	-19
40-70	TECHNICAL TRAINING	1.05	27	28	56	57	29	28

TABLE 7-19.- LOGISTICS BREAKDOWN BY DEPARTMENT

DEPARTMENT: 40-01,02,03	NAME: DIR, LOGISTICS DIR, LOGISTICS OPERATIONS DIR, LOGISTICS SUPPORT
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
MANAGER, STAFF	MANAGEMENT OF DIRECTORATE - ENSURE COMPLIANCE TO THE OVERALL LOGISTICS SUPPORT PLAN
MANAGER, STAFF	MANAGEMENT OF LOGISTICS OPERATIONS - DIRECT AND MANAGE SUPPLY SUPPORT AND TRANSPORTATION ACTIVITIES
MANAGER, STAFF	MANAGEMENT OF LOGISTICS SUPPORT - DIRECT AND MANAGE PROCUREMENT, LOGISTICS ENGINEERING AND TECHNICAL TRAINING ACTIVITIES -DIRECT PROPERTY ADMINISTRATION

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 DISSOLVED DEPT 40-10 PLANS, SYS & AUDITS

DELTA: -20

TABLE 7-19.- CONTINUED

DEPARTMENT: 40-30, 32, 33, 34	NAME: MGR, SUPPLY SUPPORT MGR, STORAGE & DISTRIBUTION MGR, SHUTTLE PROCESS SUPPORT MGR, LOGISTICS SUPPORT - GROUND OPS
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
WAREHOUSING	MINILOAD OPERATIONS, MOD KITTING, POL OPERATION, CENTRAL WAREHOUSE SUPPORT, BENCH STOCK SUPPORT
VEHICLE PROCESSING SUPPORT AREA	PROCESSING ORBITER MODIFICATIONS/FLIGHT KITS, HARDWARE DISPOSITION AREA OPERATIONS, COMPUTER TERMINAL OPERATIONS, FLIGHT SPARES WAREHOUSING/RECEIVING OPERATIONS
RECEIVING	MATERIAL RECEIVING DOCK OPERATIONS, MATERIAL INCHECKING, MATERIAL/COMPUTER MESSAGE MATCH OPERATIONS
VAB HIGH BAY II SUPPORT OPERATIONS	PROCESS PMRs TO SUPPORT ORBITER PROCESSING RECEIVE, STORE, ISSUE TEMPORARILY REMOVED FLIGHT HARDWARE
MSC OPERATIONS (SHUTTLE AND GROUND OPERATIONS SUPPORT)	PROCESS PMRs TO SUPPORT ORBITER PROCESSING GSE PROCESSING, SUPPORT EQUIPMENT MOVE AUTHORIZATION PROCESSING, SHELF LIFE CONTROL

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

REDUCTION BASED IN PART ON INCREASED AUTOMATION. EITHER IN WORK OR PLANNED
1. CONSOLIDATION OF INVENTORY IN ONE LOCATION FROM 16 SITES DURING LATE 85/EARLY 86 ALLOWED REDUCTION IN PERSONNEL REQUIRED TO MAN THE SEVERAL VS THE ONE LOCATION.
2. MANHOUR PRODUCTIVITY RESULTED FROM:
   0 CONSOLIDATION REDUCED TIME REQUIRED TO STORE, RETRIEVE, ISSUE ANY GIVEN PART.
   0 INSTALLATION OF AUTOMATED, STORAGE & RETRIEVAL SYSTEM, CONVEYORS, NEW GUIDED FORKLIFTS WITH RF TERMINALS, THE LOGISTICS AUTOMATED STORAGE SYSTEM AND ENHANCEMENT OF AUTOMATED PROCUREMENT SYSTEM ALL REDUCED MANHOURS WHILE HANDLING HIGHER VOLUMES.

DELTA: -61

TABLE 7-19.- CONTINUED

DEPARTMENT: 40-40, 41, 42

NAME: MGR, LOGISTICS ENGINEERING
MGR, INVENTORY MANAGEMENT
MGR, LOGISTICS ENGR SUPT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVISIONING, RESEARCH, & IDENTIFICATION	CATALOG GSE ACTIVITIES, MAINTENANCE ACTIVITIES
	BUILD OR MODIFY ALL SPC KIMS DATA BASE RECORDS
STOCK CONTROL/INVENTORY MANAGEMENT	KIMS CONTROL ACTIVITIES, INVENTORY CONTROL POINT MANAGEMENT, DATABASE MAINTENANCE
REPARABLE ASSET MANAGEMENT	MONITOR DUE-IN-REPAIR (DIR), DUE-IN-EXCHANGE, AND DUE-IN-CONTRACTOR ACTIVITIES
EQUIPMENT RECORDS	LOG, SCREEN, RESEARCH, AND TAG NEW CONTROLLED PROPERTY RECEIPTS
MODIFICATION ASSESSMENT/PROCESSING	PROVIDE LOGISTICS ENGINEERING TECHNICAL INTERFACE/SUPPORT TO ENGINEERING AND OPERATIONS
PRODUCT SUPPORT MANAGEMENT	ASSURE REQUIREMENTS DEFINITION AND ASSETS AVAILABILITY FOR SUPPORT OF FLIGHT VEHICLE ELEMENTS
INTERNAL AUDIT AND INVENTORY	COORDINATE INTERNAL AUDITS AND PROPERTY MANAGEMENT SURVEYS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

KSC DESIGN ENGRG PREVIOUSLY PERFORMED ANALYSES AND PREPARED RECOMMENDED SPARE PARTS DOCUMENT FOR SPC LOGISTICS. THIS MUST NOW BE PERFORMED BY LOGISTICS ENGRG FOR ALL REPLACEMENT HARDWARE, NEW SYSTEMS AND MODIFICATIONS.(+3) THE ADDITION IS AT LEAST 11 PERSONNEL FOR THE LOAD ANTICIPATED.(+11) IN ADDITION, LOGISTICS MGMT RESPONSIBILITY FOR ALL DEVELOPMENT CENTER/CONTRACTOR GSE HAS BEEN TRANSFERRED TO SPC.(+32)

DELTA: +46

TABLE 7-19.- CONTINUED

DEPARTMENT: 40-50

NAME: MGR, PROCUREMENT

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PURCHASING/SUBCONTRACTS	SUPPORT LSOC AND ITS SUBCONTRACTORS BY PROCUREMENT OF SUPPLIES, MATERIALS AND EQUIPMENT
	ACT AS CENTRAL CONTROL POINT FOR ALL CONTRACTS WITH VENDORS/SUPPLIERS FOR NEGOTIATION AND AWARD OF PURCHASE ORDERS
	MANPOWER DRIVEN BY NUMBER OF LINE-ITEMS AND VOLUME OF PURCHASE REQUESTS
PROCUREMENT ADMINISTRATION	PROVIDE ADMINISTRATIVE/CLERICAL SUPPORT TO PURCHASING AND SUBCONTRACTS PROFESSIONALS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- VLS WORK PREVIOUSLY DONE IN PART BY SPC PROCUREMENT HAS BEEN ELIMINATED
- PROFICIENCY HAS INCREASED DUE TO MATURITY AND REPETITION IN SOME BUYS FOR PARTS ON SITE MAINTENANCE, ETC, AND A DECREASE IN NON STOCK/LISTED BUYS WHICH ARE MANPOWER INTENSIVE
- SEVERAL BPAs HAVE REDUCED MULTIPLE BY ACTIVITIES
- ITEMS REQUIRING NASA CONTRACTING OFFICER APPROVAL DEMINISHED WHEN $ LIMIT RAISED FROM $25K TO $100,000

DELTA: -14

TABLE 7-19.- CONTINUED

DEPARTMENT: 40-60 — NAME: MGR, TRANSPORTATION

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
FREIGHT TRAFFIC	PREPARE FROM SOURCE DOCUMENTS COMMERCIAL OR GOVERNMENT BILLS OF LADING
	DETERMINE PROPER FREIGHT CLASSIFICATIONS
PACKAGING/SHIPPING	PACK/CRATE OUTBOUND SHIPMENTS IN ACCORDANCE WITH APPLICABLE SPECIFICATIONS
DELIVERY	RESPONSIBLE FOR DELIVERIES OF WAREHOUSE ISSUES
	DIRECT DELIVERIES OF PREMIUM MODE SHIPMENTS
VEHICLE OPERATIONS	MAINTAIN MANAGEMENT SYSTEM TO PROVIDE TECHNICAL SUPERVISION TO ENSURE THE MOST ECONOMICAL AND EFFECTIVE UTILIZATION OF MOTOR VEHICLES AND MAINTENANCE SCHEDULES
TRAVEL	ARRANGE ALL TRAVEL REQUIREMENTS
TRANSPORTATION	MANPOWER REQUIREMENTS DEPENDENT ON INBOUND/OUTBOUND TRAFFIC FLOW

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

THE ENTIRE DECREASE IS ATTRIBUTED TO CONSOLIDATION OF STORAGE NEAR THE WORKPLACE (LC39) THEREBY DECREASING DELIVERY TIME. MOVEMENT OF TILE PROCESSING "BACKSHOP" ADJACENT TO THE OPF ALLOWS TECHNICAN DELIVERY BY HAND IN LIEU OF BY TRANSPORTATION.

DELTA: -13

TABLE 7-19.- CONTINUED

DEPARTMENT: 40-70 — NAME: MGR, TECHNICAL TRAINING

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
COURSE DEVELOPMENT	NEW COURSES ARE REQUESTED AS OPERATIONAL REQUIREMENTS ARE DICTATED
INSTRUCTION	INSTRUCTORS ARE REQUIRED TO ACCOMMODATE A MULTI-SHIFT SCHEDULE
CERTIFICATION PROGRAM	TRAINING REQUIREMENTS RECOMMENDED BY SPC MANAGEMENT ARE APPROVED AND ENFORCED BY THE CERTIFICATION BOARD
SPECIAL PROJECTS	TRAIN NASA PERSONNEL
	NEW HIRE/RE-HIRE TRAINING

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

FINDINGS DICTATED:
- 0 DEVELOPMENT CENTER/CONTRACTOR COORDINATION, REVIEW & REVISION OF APPROXIMATELY 200 COURSES
- 0 SIGNIFICANT INCREASE IN THE NUMBER OF TECHNICIAN/INSPECTOR CERTIFICATIONS REQUIRED & THE FREQUENCY OF RECERTIFICATION
- 0 THE ENTIRE WORKFORCE REQUIRES TRAINING OR RETRAINING - REHIRES APPROXIMATELY 3 WEEKS AND NEW HIRES APPROXIMATELY 5 WEEKS
- 0 APPROXIMATELY 189 NEW COURSES ARE IDENTIFIED + MANUALS NASA EMPLOYEES WILL NOW TAKE SPC TRAINING

DELTA: +29

7.11 50-XX SAFETY, RELIABILITY, MAINTAINABILITY, AND QUALITY ASSURANCE

In the aftermath of STS 51-L, both NASA and the SPC were criticized for the lack of rigorous SRM&QA oversight of processing operations. In the initial SPC contract (C.O. 143) proposal for the option period, LSOC proposed increasing the headcount level to one which generally reflected the work activity prior to STS 51-L, i.e., reducing overtime. This level of 671 for FY 1990 was also reflected in the KSC POP 87-1 and 87-2 submittals, even though in the interim period KSC and LSOC agreed that an increase in headcount to 779 was desirable. The manpower justifications presented to the review team, however, only reflected the 671 headcount.

Prior to STS 51-L, the LSOC and MTI staffing for this function numbered 565, of which 471 were in Reliability Maintainability and Quality Assurance (RM&QA). (The comparable number for the pre-SPC incumbents was 637, excluding overtime.) The pre-STS 51-L overtime level in RM&QA overall was 18 percent, yielding an equivalent level of 555 (481 LSOC, 74 MTI). The current, revised plan for FY 1990 for RM&QA amounts to 670 in equivalents (663 headcount). The major areas of increase are in LSOC quality control (+63), LSOC quality engineering (+28), and LSOC reliability/maintainability (+17), and MTI quality control (+15). (Redistributions of management personnel (-7) into the organizations bring the total difference to plus 115.)

One element of the increased staffing is related to changing QC inspector to technician ratios. In the OPF, the ratio is targeted for 1:3.5 from the pre-STS 51-L ratio of 1:3.8, a relatively minor change. (The comparable pre-SPC ratios were 1:3 for the Orbiter and 1:3.5 for tile work.) For the pad/MLP/LCC operations, the change is to a 1:5 ratio from 1:6.7. The QC for support operations will go to 1:12.5 from 1:16.9. In total, the number of inspectors would increase from the pre-STS 51-L headcount of 304 to 361 by September 1988 and 383 by September 1989. (Note that the actual onboard strength in January 1986 was 232 inspectors.)

The rationale for the above change was based on both the new OMRSD inspection requirements (Nondestructive Evaluation (NDE), structural/zonal, Tile) which in the OPF, for example, are estimated to amount to a 30 percent increase, and the quality support needed for paper review and closeout prior to key milestone reviews.

In quality engineering (QE), the increases were justified by (1) having an improved problem reporting and corrective action (PRACA) system (+15); (2) corollary increases in QE for changes in other organizations, i.e., more documents to review because of the 30% increase in OMRSD requirements, having to do skill certifications, and added inspection buy points (+10); (3) X-ray evaluations for structural/zonal inspections (+3); and improvements to the supplier quality control program (+2).

In the area of reliability and maintainability, the increase was associated with the higher levels of ESR's requiring safety assurance analyses, PRACA inputs, and Failure Modes and Effects Analysis (FMEA) and critical items

list (CIL) reviews. The justification for the additional 10 persons for FMEA/CIL reviews of all KSC GSE was questionable, since these reviews are being carried out presently, and their continuation into the FY 1990 timeframe doesn't appear necessary.

The Morton Thiokol QA/QE increase of 15 E/P's was associated with new Nondestructive Test (NDT) and NDE activities and precision measurements, increased laboratory testing and evaluations, and the additional inspections required during ET and SRB processing and, particularly, in the SRB disassembly operations in Hangar AF.

A Safety, Reliability, Maintainability, and Quality Assurance organizational chart is shown in Figure 7-11. An SRM&QA manpower bottoms-up analysis is shown in Table 7-20, and Table 7-21 is a breakdown by department.

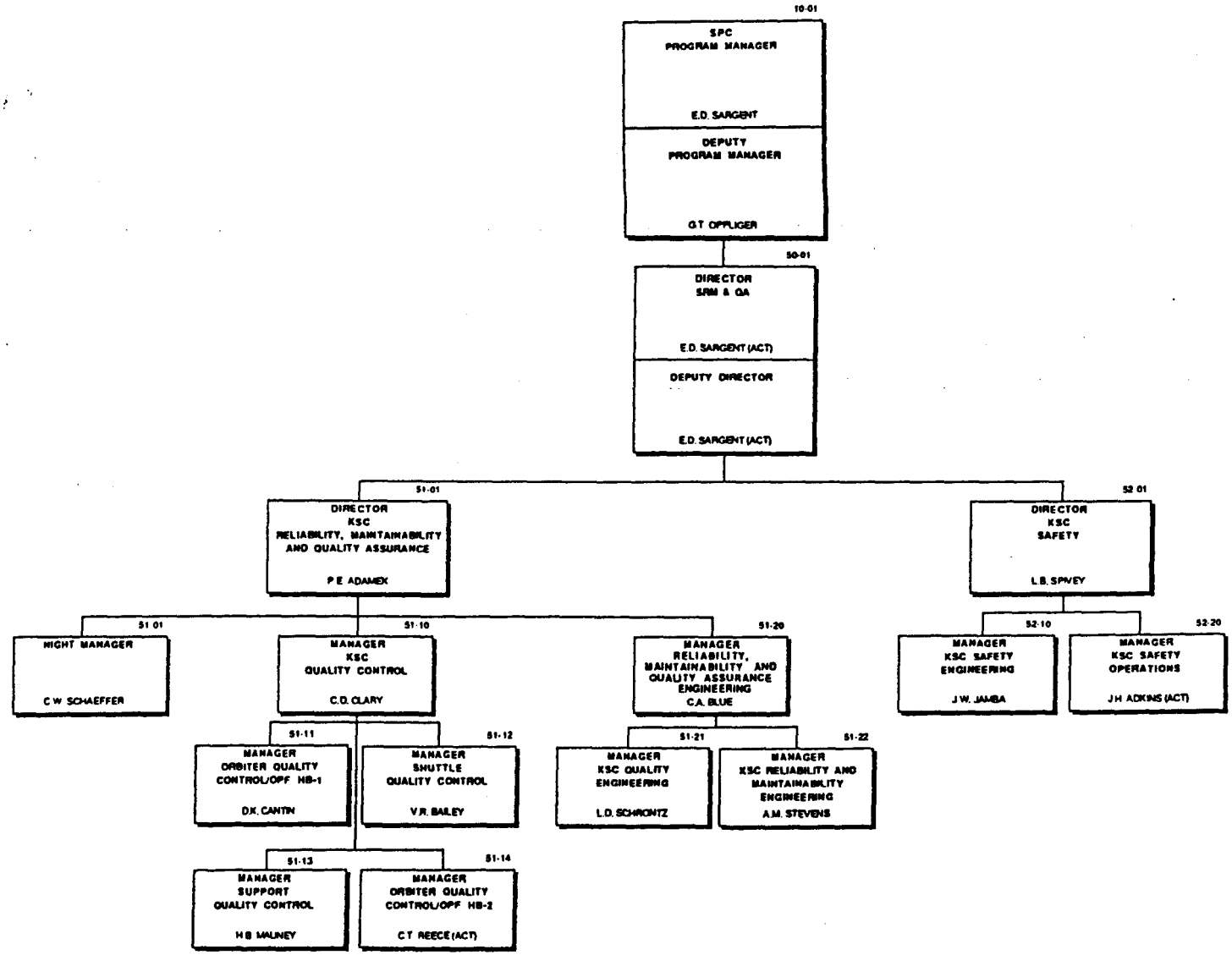

Figure 7-11.- SRM&QA organizational chart.

TABLE 7-20.

SPC MANPOWER DATABASE
BOTTOMS-UP ANALYSIS
SRM&QA

NO.	ORGANIZATION:	PRE-51L OVERTIME RATE	PRE-51L AVE HEADCOUNT	PRE-51L AVE EP	FY1990 AVE HEADCOUNT	FY1990 AVE EP	DELTA AVE HEADCOUNT	DELTA AVE EP
50-XX	SRM&QA	1.17	489	571	671	678	182	107
50-01	SRM&QA DIRECTORATE	1.04	12	12	13	13	1	1
52-XX	SAFETY	1.12	69	78	83	84	14	6
52-01	Director's Office	1.01	8	8	6	6	-2	-2
52-10	Lockheed SF Engineering	1.05	25	26	34	34	9	8
52-20	Lockheed SF Operations	1.20	36	43	43	43	7	0
51-XX	RM&QA	1.18	408	481	575	581	167	99
51-01	Management		5	6	2	2	-3	-4
51-22	Rel/Maintainability		43	51	67	68	24	17
51-1X	Lockheed Quality Control		306	361	418	422	112	61
51-21	Lockheed Qual Engineering		50	59	86	87	36	28
51-20	RM&QA		4	5	2	2	-2	-3
51-1X	LOCKHEED QC	1.18	306	361	418	422	112	61
51-10	LOCKHEED QA MGMT		3	4	2	2	-1	-2
51-11	Orbiter QC		90	106	111	112	21	6
51-12	Shuttle QC		83	98	110	111	27	13
51-13	Support QC		57	67	77	78	20	11
51-14	Flt H/W QC		73	86	118	119	45	33

TABLE 7-21.- SRM&QA BREAKDOWN BY DEPARTMENT

DEPARTMENT: 50-01

NAME: S, R, M, & QA DIRECTORATE

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE OVERALL MANAGEMENT AND DIRECTION DIRECTION FOR S, R, M, AND QA OPERATIONS AT KSC AND VLS.	TRAINING/CERTIFICATION
	SPI/MD REVIEW
INCLUDES OPERATIONS MANAGEMENT STAFF	SPC STAMP PROGRAM
	SPC AUDITS/SURVEYS
	BUDGETS/RESOURCES
	PERSONNEL ACTIONS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INTERNAL REDISTRIBUTION OF STAFF PERSONNEL

DELTA: +1

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-01

NAME: R. M. & QA DIRECTOR/SEC

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ORGANIZE, STAFF AND DIRECT THE R, M, AND QA FUNCTION TO ACHIEVE COMPLIANCE WITH CONTRACTUAL REQUIREMENTS	"ON CALL" 24 HRS/DAY 7 DAYS/WEEK
	ONE SHIFT ON CENTER
	(R, M, & QA DIRECTOR AND SECRETARY)

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INTERNAL REDISTRIBUTION OF STAFF PERSONNEL

DELTA: -3

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-10	NAME: QUALITY CONTROL DIVISION MANAGER
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DETERMINE, ESTABLISH, AND MANAGE QUALITY CONTROL ACTIVITIES IN ACCORDANCE WITH NASA REQUIREMENTS AND LSOC POLICY.	(DIVISION MANAGER AND SECRETARY)

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

DELTA: -1

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-11	NAME: ORBITER QUALITY CONTROL (OPF HIGH BAY 2)
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PERFORM INSPECTIONS/TESTS FOR ORBITER FLIGHT HARDWARE	TECHNICIAN/INSPECTOR RATIOS
ORBITER TURNAROUND	INCREASE IN INSPECTION CRITERIA
OMRF ACTIVITIES	NDE REQUIREMENTS
TEST PROCEDURES	STRUCTURAL/ZONAL INSPECTION REQUIREMENTS
OFF-SITE LANDING/FERRY OPERATIONS	MOD REQUIREMENTS
NDE INSPECTIONS	QUALITY PAPER REVIEW TEAM ACTIVITIES
DESERVICING/SCAPE	7/3 SHIFTING/1% OT
CARGO SUPPORT	
SYSTEM TESTING	
MOD INSPECTIONS	
PRE-FLIGHT INSPECTIONS	
PAYLOAD BAY SERVICING	
TILE PROCESSING	
STRUCTURAL/ZONAL INSPECTIONS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDITIONAL INSPECTION REQUIREMENTS (APPX 30%);
STRUCTURAL INSPECTION REQUDIREMENTS AND PROPER REVIEW TEAM FUNCTIONS
REDUCE OVERTIME WITH SUPPLEMENTAL MANPOWER

DELTA: +21

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-12 — NAME: SHUTTLE QUALITY CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE QUALITY INSPECTION FOR THE FOLLOWING FUNCTIONS:	7/3 SHIFTING/1% OT
LAUNCH CONTROL CENTER TESTING OPERATIONS	TECHNICIAN/INSPECTOR RATIO
PAD A/PAD B VEHICLE TESTING OPERATIONS	REDUCTION (FROM 6.7:1 TO APPX 5:1)
POST LAUNCH ASSESSMENTS	INCREASED INSPECTION REQUIREMENTS
PAD A/PAD B FACILITY MAINTENANCE	PAPER REVIEW TEAM ACTIVITY
FACILITY MODIFICATION (PAD A/B)	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDITINAL INSPECTION REQUIREMENTS, TECHNICIAN/INSPECTOR RATIO REDUCTION AND REDUCTION OF OVERTIME VIA SUPPLEMENTAL MANPOWER.

DELTA: +27

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-13 — NAME: SUPPORT QUALITY CONTROL

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE QUALITY CONTROL FOR THE FOLLOWING FUNCTIONS:	TECHNICIAN/INSPECTOR RATIO (REDUCTION FROM 16.0:1 TO APPX 12.5:1)
RECEIVING INSPECTION ON FLIGHT HARDWARE COORDINATE CHEMICAL/PHYSICAL ANALYSIS REQUIREMENTS	7/3 SHIFTING AT 1% OVERTIME
SHUTTLE ORDNANCE INSPECTIONS VALIDATE PRIORITY SPARES IN ALL LOGISTICS STORAGE AREAS SURVEILLANCE INSPECTIONS INSPECT RETURNED PARTS TAG MATERIALS WAREHOUSE INSPECTIONS CALIBRATION ACCOUNTABILITY ON ALL TEST EQUIPMENT SHOP/LABS INSPECTION REQUIREMENTS MLP OPERATIONS MICROWAVE SCANNING BEAM LANDING SYSTEM OPERATIONS	INCREASED INSPECTION REQUIREMENTS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INCREASED INSPECTION REQUIREMENTS; AND MANNING REQUIRED TO REDUCE OVERTIME

DELTA: +20

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-14

NAME: ORBITER QUALITY CONTROL (OPF HIGH BAY 1)

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PERFORM INSPECTINS/TESTS FOR:	TECHNICIAN/INSPECTOR RATIOS
ORBITER FLIGHT HARDWARE	INCREASED INSPECTION CRITERIA
ORBITER TURNAROUND OMRF ACTIVITIES	NDE REQUIREMENTS
TEST PROCEDURES OFF-SITE LANDING/FERRY OPERATIONS	STRUCTURAL/ZONAL INSPECTION REQUIREMENTS
NDE INSPECTIONS DESERVICING/SCAPE	QUALITY PAPER REVIEW TEAM ACTIVITIES
CARGO SUPPORT SYSTEM TESTING	7/3 SHIFTING/1% OVERTIME
MOD INSPECTIONS PRE-FLIGHT INSPECTIONS PAYLOAD BAY SERVICING TILE PROCESSING STRUCTURAL/ZONAL INSPECTIONS	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

ADDITIONAL INSPECTION REQUIREMENTS (APPX 30%)
STRUCTURAL INSPECTION REQUIREMENTS AND PAPER REVIEW TEAM ACTIVITIES
REDUCE OVERTIME WITH SUPPLEMENTAL MANPOWER

DELTA: +45

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-20

NAME: R, M, & QA ENGINEERING DIVISION

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE MANAGEMENT/DIRECTION FOR RELIABILITY, MAINTAINABILITY AND QUALITY ENGINEERING FUNCTIONS	DIVISION MANAGER AND SECRETARY 5 DAYS/1 SHIFT

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

INTERNAL REDISTRIBUTION OF STAFF PERSONNEL

DELTA: -2

TABLE 7-21- CONTINUED

DEPARTMENT: 51-21	NAME: QUALITY ENGINEERING
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE QUALITY ENGINEERING FOR THE FOLLOWING FUNCTIONS:	INCREASED OMRS REQUIREMENTS
EVALUATION OF GROUND SUPPORT EQUIPMENT	PROCESS ENGINEERING DOCUMENTATION OUTPUT INCREASE
DEVELOP/OPERATE TREND ANALYSIS/RECURRENCE CONTROL AND PROBLEM ASSESSMENT PROGRAM	7/3 SHIFT SITE SUPPORT
IDENTIFY INSPECTION POINTS IN TECHNICAL OPERATIONS PROCEDURES	INCREASED NDE ACTIVITIES
REAL-TIME MRB/SITE SUPPORT	INCREASED RECURRENCE CONTROL ACTIVITIES
READ/INTERPRET X-RAYS OF FLIGHT AND SUPPORT EQUIPMENT	INCREASED CORRECTIVE ACTIONS AND PROBLEM ASSESSMENT ACTIVITIES
PROVIDE ACCEPT/REJECT CRITERIA FOR PROCESSING DOCUMENTATION	
PERFORM QUALITY PERFORMANCE MEASUREMENT ACTIVITIES	
FACILITATE SUPPLIER CONTROL ACTIVITIES AND PROGRAM DEVELOPMENT	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

1) BASED ON POST 51-L STUDIES, AN IMPROVED PROBLEM ASSESSMENT/CORRECTIVE ACTION SYSTEM WAS DEVELOPED IN ORDER TO PLACE PROPER EMPHASIS ON PROBLEM TRACKING AND REPORTING IN ORDER ALLOW SUFFICIENT CORRECTIVE ACTION. (+15)

2) BASED ON INCREASED OMRSD REQUIREMENTS (APPROX. 30%), ADDITIONAL QUALITY ENGINEERS ARE REQUIRED TO REVIEW PROCESS ENGINEERING DOCUMENTATION FOR APPLICATION OF OMRSD REQUIREMENTS, SKILL CERTIFICATION AND INSPECTION BUY POINTS. DOCUMENTATION REVIEW VOLUME HAS INCREASED SIGNIFICANTLY BASED ON THE BUILDUP OF PROCESS ENGINEERING. (16)

3) ADDITIONAL STRUCTURAL/ZONAL INSPECTION REQUIREMENTS CAUSED AN INCREASE IN QUALITY ENGINEERING FOR X-RAY EVALUATION AND SUPPORT FOR QUALITY INSPECTION. (DRAWING INTERPRETATION/DATA ANALYSIS) (+3)

4) THE SUPPLIER QUALITY CONTROL PROGRAM HAS BEEN IMPROVED/UPDATED TO ENSURE THE PROPER QUALIFICATION OF FLIGHT HARDWARE (+2)

DELTA: +36

TABLE 7-21.- CONTINUED

DEPARTMENT: 51-22	NAME: RELIABILITY, MAINTAINABILITY ENGRG
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PROVIDE RELIABILITY, MAINTAINABILITY ENGINEERING FOR THE FOLLOWING FUNCTIONS:	DESIGN ENGINEERING OUTPUT INCREASES
PROPOSED SPC DESIGNS FOR GROUND SUPPORT EQUIPMENT AND FACILITIES	INCREASED LEVEL OF CIL/OMRSD UPDATES
DEVELOP/MAINTAIN QUALITY DESIGN REVIEW CHECKLISTS	
DETERMINE CRITICALITY OF KSC EQUIPMENT AND FACILITIES PERFORM FAILURE MODE EFFECT ANALYSES	INCREASED QUALITY DATA CENTER ACTIVITIES IN SUPPORT OF FLOOR OPERATIONS
IDENTIFY CRITICAL SINGLE FAILURE POINTS AND PREPARE ACCEPTANCE RATIONALE	
PREPARE/PUBLISH SYSTEM ASSURANCE ANALYSES	INCREASED DATA REQUIREMENTS FOR LSS
ASSURE DESIGN CHANGES TO SYSTEMS AND FACILITIES DO NOT COMPROMISE SYSTEM RELIABILITY	
PREPARE PUBLISH CRITICAL ITEMS LIST/ASSURE INCORPORATION OF CIL REQUIRED MAINTENANCE ACTIONS INTO THE GSE OMRSD	
OPERATE/MAINTAIN QUALITY DATA CENTER	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

1) ADDITIONAL DESIGN REVIEWS ARE REQUIRED DUE TO RETURN TO FLIGHT STATUS MODIFICATIONS AND TO PROVIDE SUPPORT FOR 100+ ADDITIONAL DESIGN ENGINEERS (+9)
2) RESUBMISSION OF FMEAs/CILs IS REQUIRED, PER LEVEL II DIRECTION, FOR ALL KSC GROUND SUPPORT EQUIPMENT (+10)
3) PRACA DATA BASE INPUT REQUIREMENT INCREASED DUE TO FLIGHT HARDWARE MODIFICATION AND RELATED SHOP FLOOR ACTIVITY (QUALITY DATA CENTER) (+5)

DELTA: +24

TABLE 7-21.- CONTINUED

DEPARTMENT: 52-01	NAME: SAFETY DIRECTORATE
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
ORGANIZE, STAFF AND DIRECT THE SPC SAFETY FUNCTION TO ACHIEVE COMPLIANCE WITH SPC CONTRACTURAL REQUIREMENTS.	SUPPORT OF 24 HOUR/DAY, 7 DAYS A WEEK TO STS PROCESSING ACTIVITIES
HAZARDOUS WASTE MANAGEMENT	

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

REDISTRIBUTION OF STAFF SUPPORT

DELTA: -2

TABLE 7-21.- CONTINUED

DEPARTMENT: 52-10	NAME: SAFETY ENGINEERING
FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
PERFORM THE FOLLOWING TASKS:	CONTRACTUAL REQUIREMENTS TO PERFORM SCHEDULED AND REAL-TIME SUPPORT OF REFERRED FUNCTIONS AND TASK
o HAZARD ANALYSIS o SUPPORT OF SUSTAINING ENGINEERING ACTIVITIES o DESIGN REVIEW o CONFIGURATION MANAGEMENT SUPPORT (SAFETY ASSESSMENTS) o RISK ASSESSMENT	TIMELY HAZARD IDENTIFICATION AND RESOLUTION
o OPERATIONAL READINESS INSPECTIONS o INDUSTRIAL SAFETY	APPROXIMATELY 19,000 PROCEDURES ANNUALLY THAT REQUIRE SAFETY REVIEW
o INDUSTRIAL HYGIENE o PROCEDURE REVIEW	TIME SUPPORT OF SUSTAINING ENGINEERING ACTIVITIES
	ASSURE COVERAGE AND COMPLIANCE WITH SAFETY REQUIREMENTS AND SPECIFICATIONS

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

- o INCREASE IN HAZARD ANALYSIS ACTIVITIES PER LEVEL II DIRECTION (HAZARD RE-EVALUATION)
- o INCREASE IN NUMBER OF DESIGN REVIEW ACTIVITIES ASSOCIATED WITH RETURN TO FLIGHT MODS
- o SUPPORT OF CRITICAL SINGLE FAILURE POINT REVIEWS
- o ADDITIONAL SUPPORT OF SPECIAL COMMITTEES/BOARDS IN SUPPORT OF 51-L FINDINGS

DELTA: +9

TABLE 7-21.- CONCLUDED

DEPARTMENT: 52-20

NAME: SAFETY OPERATIONS

FUNCTION/TASK	MANPOWER DRIVER (SKILLS)
DIRECT SUPPORT TO ALL PROCESSING FACILITIES (OPF, HMF, SLF, VAB, PAD A/B AND CONTINGENCY LANDING SITES) 0 MONITOR HAZARDOUS OPERATIONS 0 DEVELOP SAFETY REQUIREMENTS FOR PRETEST BRIEFINGS FOR HAZARDOUS OPERATIONS 0 FACILITY SAFETY WALKDOWNS AND INSPECTIONS 0 REAL-TIME REVIEW OF WORK AUTHORIZATION DOCUMENTS 0 ESTABLISH AND MAINTAIN SAFETY CLEARANCES ASSOCIATED WITH HAZARDOUS OPERATIONS 0 SUPPORT OF MISHAP INVESTIGATIONS 0 TOXIC VAPOR CHECKS AND OTHER TYPE II 0 ENVIRONMENTAL CHECKS 0 PERFORM OPERATIONAL HAZARD ANALYSIS IN SUPPORT OF SYSTEM SAFETY ENGINEERING ACTIVITIES	0 SUPPORT OF MULTIPLE FACILITIES AND SIMULTANEOUS OPERATIONS IN SUPPORT OF STS PROCESSING 0 SEVEN DAYS A WEEK, THREE SHIFTS PER DAY 0 INCREASED PROCESSING FACILITIES 0 INCREASED HAZARDOUS OPERATIONS 0 EXTENDED FACILITY MODIFICATION ACTIVITIES 0 EXPANDED CONTINGENCY LANDING SITE RESPONSIBILITIES

MANPOWER IMPACTS RESULTING FROM POST STS 51-L STUDIES

0 ADDITION OF OMRF FACILITY WHICH WILL REQUIRE FULL-TIME SAFETY COVERAGE
0 ELIMINATE EXCESSIVE OVERTIME (@21-30%) DURING HIGH PEAK STS PROCESSING
0 INCREASED REQUIREMENT FOR ON-SITE SAFETY COVERAGE
0 EXPANDED REQUIREMENT TO COVER CONTINGENCY LANDING SITES DURING LAUNCH AND RECOVERY ACTIVITIES

DELTA: +7

SECTION 8
POTENTIAL THREATS TO PROJECTED MANNING LEVELS

During the course of discussions with various NASA and contractor personnel, certain threats against the projeted FY 1990 SPC manpower levels were identified. Below, categorized by organization, is a summary listing. It should be noted that in many cases more than one SPC organization mentioned the same threat.

8.1 GENERAL

1. The composite overtime assumption of 1 percent in FY 1990 is generally disbelieved. If 5 percent is required, approximately $16 million in additional cost (~250 EP's) would be incurred.

2. Except in data systems and additional engineering support for closed-loop OMRSD's, whatever delta manpower is required for the Systems Integrity Assurance Program is not included.

3. The impact of design center involvement is not well-understood. SPC interaction with design centers may slow problem resolution and processing schedules.

4. Time allocations for accomplishing the Master Verification Plan test requirements are preliminary and may increase.

8.2 SUSTAINING ENGINEERING

1. The current backlog of engineering support requests approved through the Lockheed boards is approximately 1,000, with little likelihood with projected manning levels of reducing the backlog by significant amounts. (Note that the NASA/DE backlog count is higher (about 1,400 ESR's) since ESR's have to be approved by NASA prior to going to the SPC board.)

2. Facility/equipment drawings have excessive Engineering Orders (EO's). The acceptable engineering practice of no more than 8 to 10 EO's per drawing is being violated. Current manpower will not permit working the problem until after return to flight, due to manpower being applied to category 1 mods.

8.3 PROCESS ENGINEERING

1. Schedule impacts from design center involvement are unknown. PE assumed a 15% increase in manpower for jobs impacted by paper processing. Manpower covers only Work Authorization Documents (WAD's) that address criticality 1 items, not all WAD's. If schedule makeup pressure grows, using overtime to make up for lost time is likely.

2. PE personnel are currently attriting at higher rates than planned. If this continues, the cadre of experienced engineers will have to work higher overtime, and greater numbers of new hires will have to be brought on due to training requirements.

3. PE estimates do not include manpower requirements for the implementation of the Systems Integrity Assurance Program (SIAP).

4. PE plans to meet requirements for support to the workforce by using flex-time, a modified standard work week, and overtime at 5 percent. The 5 percent overtime is not included in current cost and manpower projections.

8.4 LOGISTICS

1. Support of aging ground systems and hardware requires, over time, increasing levels of logistics manpower. Failure to redesign and replace individual items which are marginally supportable now will increase the future workload.

2. Manpower projections are based in part on benefits being realized from automation projects not yet completed. Late completions or implementation problems will require delta manpower. (E.g., the Logistics Automated Storage System (LASS) will be tied in to the Kennedy Inventory Management Systems (KIMS) and the Rockwell Logistics Inventory Management Systems (LIMS)).

8.5 SAFETY, RELIABILITY AND QUALITY ASSURANCE

1. Manpower to support the activation of the OMRF is not included in current projections.

2. Manpower could increase due to

   a. An increase in technician numbers, requiring the hiring of inspectors to maintain ratios.

   b. An increase in process engineering document generation, leading to an increased quality engineering review workload.

   c. An increased design engineering output, requiring more reliability engineering analyses.

8.6 MORTON THIOKOL OPERATIONS

1. Manpower projections were based on known requirements for processing times with the new overtime assumptions. Any changes to the hardware or processing methods may require additional manpower. Specifically, KSC did not include a provision for significant changes in KSC processing requirements for solid rocket motors.

8.7 OPERATIONS (OPF)

1. Manning levels are somewhat below STS 51-L equivalents, based on the assumption of improvements in processing support. The 1 percent overtime assumption is not regarded as credible. The introduction of more control points, training and certification requirements, and increased testing will slow OPF timelines. The response in the past to schedule slippages has been to augment the workforce through authorization of overtime. If overtime is to be held to low levels, additional manpower on the second and third shifts (assumed to be power-off shifts) will be needed.

8.8 SHUTTLE/PAYLOAD INTEGRATION

1. Optional services in the past were covered by overtime. If the customer wants a pathfinder operations, LSOC will have to support it with overtime or additional manpower.

2. DOD requirements for a launch on need (LON) are not in the staffing baseline.

3. Contamination control manpower may not be sufficient to support the increased demand for monitoring data by scientific and DOD payloads.

SECTION 9
FINDINGS

a. The SPC manpower levels proposed for FY 1990 reflect both KSC's pre-STS 51-L processing experience and the significant changes in approach advocated by both internal and outside reviewers. To the extent that the threats (Section VIII) materialize, the estimates could be optimistic unless offsetting adjustments in approach can be implemented.

b. The largest percentage of the manpower required to support the processing facilities is relatively fixed, activity-rate driven, and insensitive to flight rate changes. Over 60 percent of the workforce would be required to support even a minimum processing level operation (1 to 4 flights per year).

c. The skill-mix changes in the workforce post-STS 51-L reflect an increased emphasis on engineering support, quality control, and the planning and control of work.

d. Unplanned work and mod traffic levels have a dramatic effect on manpower levels, schedule, and/or quality. For a given manning level and quality control, the NSTS program should recognize that authorization of unplanned work can be expected to cause schedule slips.

e. The manpower levels recommended in the KSC POP 87-1 and 87-2 submissions are 126 (headcount) lower than the 7,512 manning level resulting from negotiations between NASA and Lockheed. While the 7,512 level represents a significant increase from pre-STS 51-L equivalents, it is not conservative, and it is below the 8,000 level recommended by the managers of the LSOC departments.

f. The KSC and LSOC personnel interviewed believe that the 1 percent overtime assumption is unrealistic and unattainable.

g. The total impact of implementing design center involvement as stated in the Systems Integrity Assurance Program Plan has not been factored into the manpower estimates.

h. The number of return to flight status (RTFS) mods, excessive EO's against drawings, and engineering support requests backlogged against facilities and GSE is of considerable concern. There is some doubt as to whether the current manpower levels, coupled with a lack of appropriate tools, in Sustaining Engineering can handle the traffic at a rate which would even hold the backlog at current levels, much less reduce the backlog.

i. The proposed manpower levels do not provide a capability for full-up 7-day/3-shift operations except on a surge basis, and then only in critical path operations. The OPF is the only facility where critical path operations are planned to be conducted on a 7/3 basis. The third

shift and weekend shifts are not manned at equivalent levels to the power-on first and second shifts.

j. KSC now recognizes that the pre-STS 51-L problems, documented by the Rogers Commission, The Estess Committee, and other reviewers, that tended to strain the workforce and degrade quality were largely a result of the assumption that the SPC contract would be able to "hold the line" until the mod traffic and unplanned work could be minimized as the operation evolved into a mature airline-type operation. This assumption has been discarded, and a continuing level of mods and unplanned work has been assumed for the future. However, it also assumed that the level of pre-flight test requirements mandated for the initial flights once operations resume will be markedly reduced in order to achieve the higher flight rates.

k. Once KSC puts two vehicles in flow and a third in mod status, the facilities must be manned for critical path operations, and the flight rate will be determined by the work activity levels. Except for adding new facilities (a third OPF), a buildup of manpower relative to flight rate should not be treated as a variable.

SECTION 10
CONCLUSION

The conclusion of the team is that the revised manning levels are a result of a purposeful effort to add discipline to Space Shuttle processing.

It is felt that while this reflects additional conservatism by management, it is not at all overly conservative, and it is consistent with the abandonment of the old philosophy of progressing to an airline-type operation.

APPENDIX A
ACRONYMS

CAD	Computer aided design
CAE	Computer aided engineering
CDS	Central data subsystem
CIL	Critical Items List
CMR	contract manager representative
CPAF	Cost-plus award fee
CY	Calendar year
DE	Design Engineering
DEQ	Direct equivalent persons
DOD	Department of Defense
DR	Discrepancy report
EO	Engineering Order
EP	Equivalent person
ESR	Engineering Support Request
ET	External tank
FMEA	Failure modes and effects analysis
FY	Fiscal year
GSE	Ground Support Equipment
GTSI	Grumman Technical Services, Inc.
HMF	Hyper Maintenance Facility
KDMS	Kennedy Data Management Systems
KIMS	Kennedy Inventory Management System
KSC	Kennedy Space Center
LASS	Logistics Automated Storage System
LCC	Launch Control Center
LIMS	Logistics Inventory Management Sytem
LON	Launch on need
LPS	Launch processing system
LRU	Line replaceable unit
LSFR	launch site flow review
LSOC	Lockheed Space Operations Company
LTTS	launch team training simulator
LWOP	leave without pay

MD	management directive
MLP	Mobile Launch Platform
mod	Modification
MP	management procedure
MTI	Morton Thiokol, Incorporated
NDE	Nondestructive evaluation
NDT	Nondestructive test
NSTS	National Space Transportation System
OIS	Operational Intercommunications System
OMI	Operation and Maintenance Instruction
OMRS	Operations and Maintenance Requirements Specification
OMRSD	Operations and Maintenance Specification Document
OPF	Orbiter Processing Facility
O&M	Operation and maintenance
pad	Space Shuttle launch pad
PAO	Public Affairs Office
PE	Process Engineering
POP	program operating plan
PP&C	Process Planning and Control
PR	Problem report
PRACA	Problem reporting and corrective action
PRC	Planning Research Corporation
prep	Preparation
QA	Quality assurance
QC	Quality control
QI	Quality inspector
RCN	Requirements Change Notice
RM&QA	Reliability Maintainability and Quality Assurance
RPS	Record and playback system
RTF	Return to flight
RTFS	Return to flight status
R&D	Research and Development
SDS	Shuttle Data Systems
SIAP	System Integrity and Assurance Program
SPC	Shuttle Processing Contract
SPDMS	Shuttle Processing Data Management System
SRB	Solid rocket booster
SRM	Solid rocket motor
SRM&QA	Safety, reliability, maintainability, and quality assurance
SR&QA	Safety, reliability, and quality assurance
SSV	Space Shuttle Vehicle
STS	Space Transportation System

TAT	Turnaround time
TPS	Test Preparation Sheet
T-0	Takeoff
USBI	United Services Booster Incorporated
VAB	Vehicle Assembly Building
VLS	Vandenberg Launch and Landing Site
WAD	Work Authorization Document

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